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Leaf-Hoppers and their Natural Enemies

(PT. I. DRYINIDAE)

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LETTER OF TRANSMITTAL

To the Experiment Station Committee, Hawaiian Sugar Plantters' Association.

Honolulu, T. H., April 18, 1905.

Gentlemen: I herewith submit for publication the first part of a bulletin entitled "Leaf-hoppers and their natural enemies." It will need about eight additional parts of varying length to complete this study.

Yours obediently,

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INTRODUCTORY REMARKS

The parasites considered in this Bulletin all belong to the Dryinidae, a family of insects which, so far as is known, confine their attacks to certain groups of the Homopterous Rhynchota, popularly known as leaf-hoppers. The material which has been studied is chiefly from two sources: (1) the species observed and collected by Mr. Koebele and myself in Queensland from June till the end of December, 1904, and (2) some of the species sent to these islands from Ohio and California by Mr. Koebele in 1903; to which may be added two species peculiar to these islands. With regard to the parasites sent from Ohio and California, those which I have described below by no means include all the species sent by Mr. Koebele, and probably few or none of the rarer ones are represented. This is due to the fact that unless a considerable number of individuals were sent, I was unwilling to lose the chance of establishing a species in these islands by killing specimens for purposes of study. I now regret this fact, as had I made a critical study of these insects at that time, I should have found out what I now know, that many of the parasites sent by Mr. Koebele would not have been the least likely to accomplish the object for which they were sent, that is to attack the sugar cane leaf-hopper, since their structure is in certain respects quite different from that of those which attack leaf-hoppers of that group. From want of this knowledge much time and trouble were wasted in attempting the impossible; while several species sent, which were quite likely to attack the cane-hopper and to become established, suffered accordingly for want of attention, when this should have been entirely centered on them. The material for study that has passed through my hands, dead or alive, has been very large. Mr. Koebele sent to Honolulu from Ohio and California (but far the greater part from the former State) some three thousand cocoons, which produced several genera and many species. During the time these were being received, I bred many thousands of the Hawaiian *Echthrodelphax* for distribution in localities from which it was absent. In the six months spent in Australia, we reared a still greater number of species. Indeed when one considers that

Mr. Koebele's work in the United States was practically confined to two small areas; that nearly all our material from Australia was secured in two limited areas in Queensland, while we know that the Dryinidae are common and generally distributed in the tropics and temperate regions alike, and even occur naturally in Oceanic islands like Hawaii, it is clear that from an insignificant family with few species, this will in time become one of importance, comprising many genera and hosts of species. Particularly in Australia would the student reap a rich harvest, for it must be remembered that we were investigating these insects only during six months, and of this time only a fraction was specially devoted to them. Moreover, most of our work was done in cultivated districts, where cane is grown, or on land periodically burnt over, and greatly changed from its natural conditions, in fact such places as the entomologist bent on purely scientific research would naturally avoid. It is a remarkable fact that the student, and of course more particularly the collector of leaf-hoppers, should so rarely have noticed these parasites. One would suppose it almost impossible to collect Homoptera for a single day and not notice the conspicuous presence of the larval sac of some of the Dryinidae. They are, too, so extremely easy to breed in confinement, even under most unnatural conditions, such as in a small glass vial, that it is surprising how few have been recorded as bred.

A list of some of the later writings on this family is given below, but I have not thought it necessary to refer to those of Westwood, Walker and the old writers. References to these will be found in Ashmead's Monograph of the North American Proctotrupidae. The latter work I have studied very carefully in drawing up the characters of my new genera, and since most of the North American genera are unknown to me, and European material has not been procurable at all, I have been greatly indebted for information concerning these to the Monograph mentioned above, which includes most of the European genera.

Since that work was published, Dr. Ashmead has entirely changed his views as to the systematic position of the Dryinidae, placing them now with the true wasps, and altogether apart from the Proctotrupids. I regret that I am not at all able to follow the learned American hymenopterist in his latest views on the classification of the wasps, nor with some of his views as to the structure of certain Dryinidae, nor with his conclusions as to the significance of their chelate tarsi. These points will be discussed below.

Since the greater part of this Bulletin was written, we have received a recent paper on the raptorial front legs of the Dryinidae by Dr. J. J. Kieffer, in which figures and descriptions of these are given. The figures illustrating the present Bulletin will be published later, with those illustrating other leaf-hopper parasites.

GENERAL ACCOUNT OF THE DRYINIDAE.

LIFE HISTORY OF ECHTHRODELPHAX AS TYPICAL OF THE DRYINIDAE.

When in 1903 for the purpose of distribution in the cane-fields many hundreds of *Echthrodelphax* were kept in a cage with glass sides and large enough to contain a fair-sized growing plant of sugar cane, on which large flocks of the larvae of the cane leaf-hopper were feeding, the habits of the parasite could be studied to great advantage. By having a cage thus well stocked with the parasites, one can insure the fact that at almost any time individuals may be seen in the act of catching their prey. In such a cage, on one occasion, I counted over thirty parasites on a single cane stem each one simultaneously engaged in stinging the young hopper it had seized. When the hoppers were excreting an abundance of honey-dew, the parasites fed freely on this, but if not, some sweet liquid was supplied in place of it. Without liquid food, in a hot locality the parasites die very quickly, and the cage was freely sprinkled with water each day to advantage. Pairing of the sexes is of short duration and after copulation the male frequently never moves again, and in general dies very quickly. To watch the female parasite stalking, catching and stinging its prey, is a most interesting sight. The prey is sought on foot, for while most of the Dryinidae are most active and rapid runners, they are but poor performers on the wing. In most of the winged forms, these organs are unduly short and in *Echthrodelphax* serve hardly more than to transport it from one cane plant to another as occasion demands. As soon as the parasite becomes aware of the presence of its prey, it usually comes to a standstill, while still at a short distance; it assumes a rigid attitude comparable with that of a dog pointing game; the antennae are laid back behind the head; frequently it sidles round the hopper to gain a more advantageous position for the attack. The hoppers often show manifest uneasiness on the approach of the parasite and they

hasten to remove themselves to a distance, as the latter comes to a point. In this case they are again followed up, and the performance may be repeated several times. In some cases through too great deliberation in attack the prey is entirely lost, as it moves away into concealment and the parasite fails to trace it up. Deliberate as it often is in making the attack, yet, when made, the stroke is marvelously rapid. So quickly indeed are the front legs thrown out and withdrawn that the hopper, which just now was at a distance, in an instant appears contiguous to the parasite, as if attracted by some unseen force. One pair of pincers usually grips the neck of the prey the other frequently clasps the pair of hind legs in the neighborhood of their long jumping spurs, or the abdomen towards the apex. If the hopper is unusually large and strong compared with its enemy, it not rarely manages to make its leap, and both fall to the ground together. Never however was the latter seen to relinquish its hold on the former. Its prey firmly secured and frequently held more or less crosswise to itself, the parasite now curls round the abdomen and thrusts its sting into the side of the hopper, beneath one of the wing lobes in the case of *Echthrodelphax,* and in various other positions in the case of other parasites, and the egg is deposited. The laying of the egg is again a very deliberate undertaking and the sting may remain inserted for a couple of minutes or more. Finally the sting is withdrawn, the front leg that grasps the hopper's neck is extended, the chelae or pincers fly open and the hopper is sometimes roughly jerked to a distance, sometimes more gently deposited on the plant. While grasping the hopper and inserting the sting, the parasite has been seen in some cases to freely use its mandibles on the neck in process of malaxation. After the operation, the victim usually appears weak and dazed, sometimes even lying inert on the ground, but sooner or later and sometimes very quickly, it recovers and starts feeding as if nothing had happened. Occasionally after capture, the prey is released without being stung, and it is probable that hoppers so released have already been stung by an earlier captor. Under unnatural conditions, such as in the confinement of a small jar or glass tube, and probably under pressure of hunger, the hoppers are frequently killed outright, and to some extent devoured. The position of insertion of the sting is apparently not always the same, this being sometimes inserted beneath the wing-lobe, and sometimes in the ventral side of the body, but the larval sac in either case appears beneath the wing-lobe. After the egg has been

deposited, it is not for some time that the characteristic larval sac becomes evident externally. In the case of *Echthrodelphax*, I could distinguish the larval sac, having the appearance of a minute transparent vesicle, at the end of four days with the naked eye In the case of a California species of *Haplogonatopus*, the period was not less than a week. On one occasion three cane leaf-hoppers were placed in a large glass jar with the *Haplogonatopus*, and two of them were seen to be quickly seized and stung. The next day the parasite was removed to another cage. At the end of six days, when the hoppers were examined, no sign of the larval parasite was noted, even with the aid of a weak lens, and it was supposed that they were unaffected. However on the ninth day, when they were again examined, the parasitic larvae were of considerable size, and obvious to the naked eye. The third hopper of the above produced no parasite and probably was not stung. As soon as the larval sac becomes visible, it is usually but a short time, a few days or a week before the larva becomes mature. The length of time no doubt varies somewhat according to the species, and according to climatic conditions.

The larva of the *Echthrodelphax fairchildii* while still attached to the hopper, appears as a small, nearly circular, impressed, black object, adherent to the young leaf-hopper. The latter seems hardly to be inconvenienced by the parasite, remaining as active and plump as the non-parasitized individuals. It is always the immature hopper that is attacked and a single hopper may sustain one or two parasites. They are generally fixed beneath the lobes, which develop into the tegmina or upper wings, one on each side of the body, if two be present; they are, however, sometimes found beneath the true wings.

After a time, however, (always shortly before the full growth of the parasitic larva) the hopper becomes sluggish and then entirely stationary. This may happen either shortly before or not till some time after the black shell-like covering or larval sac of the parasite splits by a longitudinal (mediodorsal) fissure and exposes the back of the white maggot within. This torpidity of the leaf-hopper and the splitting of the covering of the parasite is the outward sign of a change of habits in the latter (being coincident with a moult and change of form of the parasite). From this time until the hopper dies and the maggot finally quits hold of its prey the sight as examined under a lens forms one of the most repulsive sights that natural history can afford.

Soon after the splitting of the black covering and the exposure of the white maggot, a conspicuous change takes place in the color of the latter, it becoming pink or reddish. The maggot, which has hitherto fed delicately without doing any vital injury to its host, now proceeds to ingest the contents of the hopper in an indiscriminate manner, and the change in color is clearly due to this. If removed at this time from the hopper it is seen to have very mobile and hard (chitinized) mouth parts, while the thin and collapsed black covering still adheres some distance behind the head. Growth is extremely rapid and the simultaneous shrinking of the hopper, as its contents are absorbed by the parasite, enhances this effect. Thus when the splitting of the black covering takes place the hopper may be three or four times the size of the parasite, when the latter is full fed the proportions may be exactly reversed. The removal of the contents of the hopper can be easily seen through parts of the cuticle. Generally early in the proceedings the soft contents of one or both eyes and of the head are seen to be in rapid motion, like a boiling fluid; suddenly all the pigment is removed from one eye (usually the one on the opposite side to the parasite) and it becomes an opaque white spot, then the other is often similarly destroyed, or sometimes both more or less simultaneously.

Finally the maggot, when it has finished feeding, withdraws its head, and may then sometimes be seen busily engaged in applying sticky matter from its mouth to its body. Its surface is strongly adhesive and when it quits its prey, it is able (though of course quite legless) to crawl freely over any surface, however smooth. Soon it spins a neat white cocoon, from which it emerges as an active winged insect in about 18 days.

GENERAL HABITS OF DRYINIDAE.

In Australia, the small apterous forms of the *Gonatopus* type are essentially attached to the Jassidae and Fulgoridae, that feed on grasses and low herbage, and this was also the case with the many American species sent to Hawaii by Mr. Koebele. On the other hand, the Hawaiian apterous species are essentially arboreal, but it must be remembered that in Hawaii practically all the native Homoptera are attached to forest trees, the few that live on grasses being Jassids or Fulgorids almost certainly introduced, the Hawaiian fauna being altogether of a special nature. *Echthrodelphax* is also connected with grass-eating Fulgorids, or at least with those affecting low plants. The most

minute species of *Neochelogynus* attack small graminivorous Jassids. The larval sac of these small robust insects is placed ventrally on the hopper behind the posterior legs, or on the side of the neck. Most of the species of this genus, however, attack tree Jassids, and the larval sac is attached behind the posterior coxae on the ventral surface of the body. Naturally all these insects are at times met with in the adult state by sweeping grasses, but not in any considerable numbers. The apterous insects of the *Gonatopus* group can be found in some numbers by special searching about the roots of grasses in Australia, especially on sandy banks, similar to those on which I used to take *Gonatopus* itself in some numbers twenty years ago in England. The tree-frequenting winged forms are only taken rarely and singly, by beating branches of trees or shrubs, even in places where the dryinized hoppers are quite abundant, and where the mature insects can be obtained in numbers by breeding. *Paranteon* no doubt has special habits; for the sluggish hopper, that it affects, forms flocks of greater or less extent, and excreting much honey-dew, is invariably covered with swarms of ants, usually a moderate-sized species of the Formicidae. The *Paranteon* bears some slight resemblance to the ant in appearance, and this resemblance is enhanced by its actions. If a number of the parasites be bred together in a glass vial, they may be seen gathered in pairs, standing sub-erect on their four hind legs, face to face, stroking one another, licking each other's mouth, soliciting food. Now the ants, that attend the hoppers, themselves behave in similar fashion, and it is most probable that they actually feed the *Paranteon*, which unless it were on friendly terms with the ants could never approach the hoppers to lay its eggs in these. It is only necessary to touch a twig on which a colony of the hoppers rest, to see how assiduous are the ants in protecting the colony from any interference. Further, it would be interesting to note what happens to the full-grown larva of the parasite, which must emerge from its sac amongst a swarm of carnivorous ants, that are always prepared to kill and carry off any weaker insect, that falls in their way. Most probably not only are the larvae not harmed by the ants, but they may be carried down by them to their underground nest, and pupate therein. In captivity the larva forms its cocoon well beneath the soil.

All the species of the Dryinidae, which have the front legs abnormally lengthened in the females, when resting, place these in a characteristic position. The knee-joints on either side rise

high above the pronotum and often are brought together so as to form a complete angular arch over the thorax. In walking, the abnormally developed claw of the chelae is always folded back on the fifth joint of the tarsus, and is not used except specially for grasping its prey. In the comparatively slender, winged insects of the genera *Neodryinus, Paradryinus* and *Chlorodryinus*, the abdomen of the females is recurved or bent on its apical part, and is always kept in this position when the insects rest, and generally when hunting their prey; and this is also the case with the large apterous *Chalcogonatopus*. When at rest they have a most extraordinary appearance for they sit sub-erect on their tail (i. e. the recurved apex of the abdomen), supported otherwise by only the two hinder pair of legs, the front pair being held in the position already described, the tarsi usually somewhat inclined, and free from the surface on which the others rest. On the other hand, the slender, winged *Echthrodelphax*, and the small wingless insects of the *Gonatopus* group, whether resting or running, hold the body segements straight, and only in the act of stinging their prey are these bent or recurved.

The short-legged, stout insects with large stigma to the front wings naturally do not exhibit the peculiarities that are shown by the species of the above named genera. Many of them, moreover, seem to be better endowed with powers of flight, the sexual disparity is much less, the males are more hardy, and, in the case of *Paranteon* at least, copulation may take place many times, in striking contrast with the feeble male of *Echthrodelphax*, which frequently drops dead within a few minutes after the act.

Although in some cases a species of the Dryinidae will attack more than one species of leaf-hopper, and indeed sometimes parasitizes species of different genera, yet in the latter case these genera always belong to the same group of hoppers. In no case have we ever found one to attack a Jassid or Fulgorid indiscriminately. Indeed from a study of structure we should suppose such a case to be impossible. Riley however is said to have bred *Labeo typhlocybae* from a *Typholocyba*, whereas this species of which the female was described as *Dryinus ormenidis*, is well known to be a common parasite of the Fulgorid genus *Ormenis*, and it might be well to confirm Riley's unique instance. Also in need of confirmation is Lichtenstein's *Gonatopus ptinorum*, said to be parasite on the beetle *Ptinus fur*.

Like other parasitic Hymenoptera some of the Dryinidae are

able to reproduce their kind parthenogenetically, and probably frequently do so in a state of nature. In one case that was noticed, that of a species of *Pseudogonatopus,* of the offspring thus produced only one in forty was of the male sex.

THE ECONOMIC VALUE OF DRYINIDAE.

The parasites of the group now under consideration have until lately been considered as more or less rare insects, and therefore it is of interest to consider the extent of their economic value. A fairly true estimate of this value can be made by carefully watching some common species of leaf-hopper, which is subject to their attacks, over a considerable period of time. It must be understood that the following remarks apply to species, which are found in countries where the winters are not cold enough to put a cessation to insect activity. If we keep watch on a species of hopper from the time when its numbers are at a minimum, it will usually be observed that the individuals become more and more numerous with each generation. At first the parasite is also very scarce, or for a time may not be observed at all, but it likewise increases in number with the increase of the hopper, so that both frequently attain their greatest abundance at the same time. In the case of a common Australian species of grass eating *Liburnia* and the *Pseudogonatopus* parasitic on it, which were observed for about three consecutive months, the visibly parasitized individuals, when the hoppers were most abundant, amounted to as high as 50 per cent of the whole. Many individual hoppers carried two to four, some even six parasites. Adults and all the earlier instars were attacked alike. This statement however would give a very inaccurate idea of the true value of the parasite. Firstly, many of the apparently sound hoppers were affected by the parasite, which had not yet shown externally; secondly, an enormous proportion of them were in the young stages and incapable of breeding, and, for days or weeks to come, were liable to be parasitized before they could reach maturity. It will not therefore be surprising to learn that a few weeks after the parasites were at their maximum, the hoppers from their numerical maximum fell suddenly away to a minimum, being represented, in places where they had swarmed previously, by only scattered specimens.

It might have been expected that now the parasite would have been swarming in the locality, where so many dryinized hoppers had lately existed, the more so as, on account of their

wingless condition, they would not be likely to stray far away from their birth place. This however was not the case, for just as the parasite reaches its maximum in numbers, at the same time as the hopper, so do the hyperparasites at the same time as the parasite. When the *Pseudogonatopus* was at its greaest numbers, the hyperparasites were noticed in the field in considerably greater numbers still. Of course it must also be remembered that in many cases the destruction done by the Dryinid parasite is supplemented by the work of other parasitic or predaceous insects. With the most successful hoppers (by which I mean those, which are most numerous in individuals), it would appear that at their numerical maximum, they exhibit signs of becoming a highly destructive pest, but just at this point (at any rate in normal seasons), they suddenly, owing to the attacks of parasites or predators, fall away to about their numerical minimum.

To take another instance, a common species of *Siphanta* was observed in numbers in Northern Queensland in various localities, but not so numerously as a rule as to be considered injurious to any considerable extent. On the other hand, under unnatural conditions, it showed itself capable of doing the greatest damage, for an isolated colony established on a bush in the town of Cairns where its natural enemies had little chance of finding it, had so injured the bush that the owner cut away and destroyed a large portion of it. At Townsville, on an isolated row of trees, the same species had evidently increased to great numbers prior to our visit, as could be easily seen by the appearance of the affected trees, and the empty larval skins of the Siphanta. In this case, however, the parasites had already discovered their prey, and we saw few of the latter, but the cocoons, mostly empty, of a *Neodryinus* were so numerous, that as many as 32 were picked off a single fig-leaf! Egg parasites were also at work on the few patches of eggs that we found. Indeed in most cases, it will no doubt be found that the work of the Dryinidae, admirable as it is, to a greater or less extent is supplemented by that of other predaceous and parasitic insects. In fighting a leaf-hopper pest by the importation of parasites or predators, it will no doubt be generally found necessary to make a selection of carefully chosen enemies rather than to rely on a single specific enemy, though the latter might in some cases be perfectly successful, provided its hyperparasites be carefully excluded and that none likely to attack it already exist in the country to which it is imported.

How hardly the Dryinid parasites are at times pressed by their various hyperparasites, we often observed. To cite one instance, from about fifty cocoons of several species of parasites, obtained from grass-eating Liburniae at Redlynch near Cairns, one solitary male *Echthrodelphax* alone emerged, all the rest being hyperparasitized, and similar observations were made in several localities.

In estimating the value of the Dryinidae we should note the fact that, so far as is known, a dryinized leaf-hopper may be counted as a dead hopper. In no case is it probable that it would be capable of reproduction after being stung by the parasite, and usually it dies at the moment of emergence of the larva of the latter. In one instance a very large nymph of a *Siphanta*, bearing a larva of a *Paradryinus*, after the latter left it, had sufficient strength to moult, and produced a crippled mature insect, which quickly died; but this case was quite unique. Nymphs of leaf-hoppers bearing a parasite never attempt to moult. On the other hand, where a Dryinid attacks mature leaf-hoppers, these may of course have already deposited their eggs, but such cases are probably few.

MATURE LARVAE OF DRYINIDAE.

On leaving the host, the full-grown larva* is of elongate-ovate form, pointed anteriorly when extended, the anterior segments being much narrower than the posterior, the head more or less retractile and like the mouth parts, usually very mobile. The cuticle is microscopically rugulose or corrugated, sometimes quite bare as in some *Neodryinus* and *Paradryinus*, but in *Pseudogonatopus* (at least in some species), there are several longitudinal rows of very short and widely separated bristles and a row of latero-subventral ones on each side are more developed, placed on tubercles more developed than the others. In *Neochelogynus destructor* the segments are circularly ridged and the ridges set with minute tubercles placed close together, each tubercle bearing a longish hair.

The chitinization of the head varies in different genera or species, but conspicuous always are the large mandibles. In some *Neodryinus* and *Paradryinus* these appear to have an oblique cutting edge, which is crenulate or denticulate. In *Neochelogynus* they appear to be simple and simply pointed at

*The larva of Gonatopus has been fully described by Mik (see bibliographic list.

the apex, and at rest the tips pass one another. The upper lip or labrum is very broadly rounded or truncate at the apex and there ciliated, and often the mandibles are largely concealed beneath it. The lower lip apically is usually strongly bent upwards at an angle with the lower surface of the head. The mouth opening is large and only partially closed by the large mandibles and the maxillae, which lie beneath them. There is a single-jointed (faint indications of a secondary division may sometimes be noticed) maxillary palp, bearing a few microscopical hairs at its apex, or sometimes one more conspicuous spinose hair and some shorter ones. The head is sparingly set with hairs or bristles which differ with the species, and these distinctions possibly yield characters of generic importance.

All the larvae known are very active and most of them crawl about quickly on their emergence from the sac, in search of a proper place for spinning their cocoons. Some however like *Neodryinus* pupate on, or close to, the spot at which they issue from the host. They show many differences in colour, according to the species, the majority being white or pinkish. Some however are brown and others light green. It is noteworthy that a light green larva may issue from the sac on a brown coloured Jassid, while another species from a light green Jassid may not be green at all. These colour distinctions are, I believe, constant for a species.

COCOONS OF DRYINIDAE.

The larvae of all the known species spin a compact silken cocoon, which often consists of two parts, an inner adapted to the form of the larva and an outer and wider covering. The species of *Neodryinus* further elaborate this by fixing over it a roof, formed of the greater part of the larval sac. Many of the cocoons are highly characteristic of the genus or species, and though in some the details of shape, etc., are not absolutely constant, yet in many cases the species can be immediately distinguished by an examination of the cocoons, provided that these are formed on similar substances. When found on very different surfaces there may naturally be considerable difference exhibited by cocoons even of one species. The cocoon of *Paradryinus* is elongate and cylindrical and often found on the surface of green leaves. Under these conditions the cocoon of *P. threnodes* is densely studded with round patches of epidermis stripped off from the leaf surface; that of *P. koebelei* is less densely covered, with more

elongated fragments; while *P. venator* also uses roundish fragments, but the cocoon is more carinated.

The cocoon of *Chlorodryinus* is long, narrow and cylindrical and no fragments of leaf substance are woven into the surface. That of *Neodryinus* is ovate and the upper and lower walls of the marginal part are strengthened with great numbers of vertical pillars. In addition as above mentioned, the larger part of the ruptured larval sac is removed from the hopper and attached as a roof over the cocoon. This sac being of the usual circular form, when ruptured by the escaping larva, gapes open like a bivalve shell, as do those of all other Dryinidae known to us. These two valves are stretched wide open over its cocoon by the mature Neodryinus larva, and so fastened, the whole forming a subovate or subreniform roof over just so much of the whole cocoon as covers the insect within. Of what use to the genus this extra shelter may be, we cannot conjecture. It certainly does not make the cocoon less conspicuous, as do the fragments from the surface on which it pupates that of *Paradryinus*, nor yet does it keep out the spores of fungi to which both genera and some others are very liable. All the known hyperparasites attack the larva before the cocoon is made and not afterwards, so they do not enter into the question.

The cocoons of the short-legged genera, with large ovate stigma to the front wings are almost certainly under natural conditions subterranean. They are of shorter, wider form than those of the more highly evoluted group of genera; in fact, often nearly round, and are covered with particles of the soil or debris amongst which they are formed, so as to be most difficult to detect by sight.

LARVAL SAC OF DRYINIDAE.

The larval sac of the Dryinidae is of circular form, the sides being more or less compressed according to the species. The colour is frequently uniform, but in some species it is more or less, or even conspicuously, variegated. Towards the point of attachment the surface is often nearly smooth and sometimes shining, but externally more or less rugulosely sculptured. This sculpture is sometimes so well-marked and the pattern so regular, that under a strong lens the surface of the sac presents a really beautiful appearance. In some species the external rugulose portion bears short, stiff, erect, bristles. The larval sac is formed of the skin of the curled up larva together with one or

more of the adherent skins of its earlier ecdyses. After a careful examination of the sacs of a large number of species, it would appear that the full number of larval moults is four (or possibly even five) but in some species the number may be reduced. At least in the case of a species of *Neodryinus* that was most closely investigated the number of ecdyses cannot be less than four (including that from larval to pupal condition) as is evident from an examination of the sac. In this genus the sac is partially removed to form a cover for the cocoon when the larva leaves its host. This cover is subovate or reniform and consists of two distinct larval skins attached to one another, longitudinally fissured at the moults and spread out valve-like, the smaller surrounded by the larger. Each of these skins is pierced by nine spiracles of which one (at the one end of the series) is indistinct in the larger skin. Besides these, one still smaller skin is left beneath the wing-lobe of the host and this is also distinctly pierced by a series of spiracles. It is possible that there is yet another smaller skin more internally placed, though this was not observed. Therefore there are at least four and possibly five moults in this species.

POSITION OF THE LARVAL SAC.

In dryinized Homoptera there is great diversity in the position of the larval sac. The position may vary in the case of a single species, or in different species of a genus, or it may be absolutely constant, and not only in a species, but apparently in all the species of a genus.

In most of the species of *Neochelogynus* the larval sac is ventral, and lies immediately behind the posterior coxa; in *N. coriaceus*, however, it is placed at the side of the neck. In *Paranteon* the larval sac is placed either dorsally or ventrally on any abdominal segment, as many as six or eight on a single individual; more rarely it has been found beneath the thorax, at the insertion of the hind coxae or on the prothorax laterally or beneath. In *Pseudogonatopus* the sac is always dorsal or dorsolateral on the abdomen and several sacs may be found on one Delphacid. In *P. stenocrani* on the nymph of *Stenocranus dorsalis* the sac stands up erect like a wheel in the middle line between the wing-pads, giving it a most extraordinary appearance. All the species of *Echthrodelphax, Paradryinus, Thaumatodryinus* and *Neodryinus* have the larval sac placed beneath one

or the other wing lobe without variation. In *Eukoebeleia,* the sacs are abdominal, variously placed, often several on one host.

ABNORMAL LENGTH OF TIME SPENT IN THE COCOON.

Considering the whole number of species of Dryinidae known to us, the average length of time spent from the period of spinning the cocoon to the emergence of the mature insect, would be from two to five weeks. Consequently as the egg state and the larval stages are known to be of short duration, many generations can be produced in a year. There comes a time however when, owing to the absence of the host in a suitable stage of development for the parasite that attacks it, or for other reasons, the Dryinid itself has to assume a lengthy resting period. So far as our observations go, this resting stage in the case of the parasite always takes place when the larva has spun its cocoon and before pupation. No doubt in countries with cold winters many pass the winter months in this stage; and in warm countries this quiescent condition is liable to be assumed at any season. During the summer months in Hawaii, occasional larvae of *Echthrodelphax* assume this torpidity in the cocoon, remaining in this condition for months, though perfectly healthy; and in some of the winter months the number that remain as larvae, when others (collected at the same time and treated in the same manner) emerge after the usual period, may amount to not less than 25 per cent. There is reason to suppose that not only a lowering of temperature, but that dryness even with increased temperature, may in some cases cause this torpidity. About 2,000 cocoons of *Dryinus,* sent to Hawaii from North America by Mr. Koebele, in the early part of November, produced in Honolulu two males a few weeks after arrival, and one male a month after these. The rest remained as torpid and shrunken larvae in the cocoons for five months after they had been collected. They were then taken to a cooler and damper locality, and all that were not killed by hyperparasites produced mature insects of both sexes in a short time. A number of curious cases were noticed in Queensland. For example, a larva of a *Paradryinus* that spun up on Oct. 1st, was still in the larval state, and, as evidenced by occasional movement, alive on Dec. 12th, though much shrunken. It was then killed and preserved. Larvae of this same *Paradryinus* that formed their cocoons in

numbers on Nov. 22nd, had all emerged as perfect insects before Dec. 12th. The cause of the retardation in development is not clear in this case, but that it may under certain conditions be of an advantage to the species is evident. This would especially be the case in a country subject to long droughts, when vegetation of many kinds is dried up for long periods together, during which the hosts of these parasites must almost cease to exist in a proper stage of development for their attack. It may also be of use against the attack of hyperparasites, if, as it appears, these have not the same habit of lying dormant, except of course during winter in cold countries.

COMPARATIVE STUDY OF GENERIC CHARACTERS OF DRYINIDAE.

(*a*). *The Mouth-parts.*

The mouth-parts have been largely used in the classification of the *Dryinidae* by other writers, and they are largely employed in this paper for generic differentiation, as I am convinced of their importance. Obviously the series of genera here considered may be divided into two groups (1) those with short maxillary palpi, always less than 6-jointed, and two-jointed labial palpi; (2) those with long or moderately long 6-jointed maxillary palpi, and with three-jointed labial palpi. If however, the number of joints of the palpi in several genera (not accessible to me) as given by Ashmead is correct, then this division will no longer be of the natural character it appears to be, when based on the species and genera herewith described. The only case where it may be necessary to reconsider the generic value of the number of joints in the maxillary palpi is that of *Gonatopus* (if indeed my species is truly that genus) and *Neogonatopus*. Excepting in the number of these joints, *G. australiae* and *N. dubiosus* are practically identical, and might be the same species; but in all other cases, where I have used them to distinguish allied genera, the maxillary palpi are essentially different. The maxillary palpi in the *Dryinidae* are from two-jointed to six-jointed. In all the genera with narrow elongate stigma to the front wings and with perfectly chelate, long front legs, these palpi consist of a basal part and an apical, distinguished by a natural geniculation at their meeting. The basal part consists of one or two joints; if two-jointed, the first is extremely short and sometimes even

obscure. As however it is so certainly homologous in all genera, though better developed in some than in others, it must certainly be counted in all where visibly present, or in none.

It appears to me after a comparative study of the base of the palpi in other Hymenoptera, that what I here count as the basal joint is sometimes considered a true joint by authors, sometimes as a 'palpiger' or process of the maxilla. In the Dryinidae in many forms there can be no doubt that it is a true moveable joint (as can easily be seen by watching a species under the microscope, as it recovers from narcosis), and I must repeat that it is obviously homologous throughout all those genera, in which it can be at all distinguished. I have drawn the palpi of most of the genera with the aid of the camera lucida to show the basal joints, but owing to our isolation these figures cannot be reproduced before the final part of this Bulletin is completed. I may add that it does not appear that the validity of any of the genera described by me would be affected in any case. Thus it is true that leaving out this basal joint my *Chalcogonatopus* would have 5-jointed maxillary palps, which is said to be the character of *Gonatopus* proper, but then the latter has 2-jointed, the former three-jointed labial palpi.

In *Paragonatopus*, *Haplogonatopus* and *Epigonatopus* only, this short basal joint is apparently absent; and there is therefore only a single joint before the geniculation in these genera; which also agree in having only a single elongate apical one beyond the geniculation.

The less specialized forms with large ovate stigma *Paranteon*, *Prosanteon* and *Neochelogynus* agree in having six-jointed maxillary palpi, as also do *Neodryinus*, *Chlorodryinus* and *Paradryinus;* and all these genera have three-jointed labial palpi. With these latter genera, and in my opinion related to *Neodryinus*, though apterous, and with the thoracic structure of *Gonatopus*, must be included *Chalcogonatopus*, with its similar labial and maxillary palpi. On the other hand, *Echthrodelphax* with its short maxillary and labial palpi resembles *Pseudogonatopus* and is obviously allied to this. Indeed I should consider that the latter and the allied apterous genera have been derived from some such form as the Australian *Echthrodelphax*, while *Chalcogonatopus* has arrived at a similar general structure, quite independently, from some such form as the Australian *Neodryinus;* the apterous condition having been accompanied with similar and remarkable changes in the thorax in each case.

The mandibles in all the species examined by me are tridentate or quadridentate. The genera with largely stigmated wings have the mandibles 4-dentate in both sexes alike, but excepting the anomalous *Eukoebeleia*, all the others, where the sexes are known, have 4-dentate mandibles in the female, 3-dentate in the male.

Tabulating these results, we find:

A. Mandibles of male and female with four teeth; maxillary palpi 6-jointed, labial palpi three-jointed.............
.................*Neochelogynus, Prosanteon, Paranteon.*

B. Mandibles of male 3-dentate; of female 4-dentate, maxillary palpi, 6-jointed, labial three-jointed.............
..................*Neodryinus, Paradryinus, Chlorodryinus* (probably *Thaumatodryinus,* and *Chalcogonatopus.*

C. Mandibles of male 3-dentate; of female four-dentate; maxillary palpi less than six-jointed; labial palpi 2-jointed..
.... *Pseudogonatopus, Paragonatopus, Haplogonatopus, Gonatopus, Neogonatopus, Pachygonatopus* and *Echthrodelphax*

So far as the Australian, American and Hawaiian material at my disposal is concerned, this is a quite natural division or classification of the genera, but the characters given by Ashmead for others, which I have not seen, will, if correct, upset this most natural arrangement. Thus the largely-stigmated genera *Anteon* and *Chelogynus* would, one would have expected, have three-jointed labial palpi and 6-jointed maxillary. In *Dryinus* with its 6-jointed maxillary palpi one would look for 3-jointed labial palps, like *Neodryinus;* and in fact *Dryinus ormenidis* Ashm. has them so, as well as quadridentate mandibles, and therefore does not enter the genus *Dryinus* at all as characterized in the Monograph of the N. A. Proctotrypidae.

Unfortunately I have not been able to investigate the males of many genera, but all those examined by me resemble the females in the number of joints of the labial and maxillary palpi, though frequently differing somewhat in the character of these joints. Should it prove that the males in the difficult series of forms resembling *Gonatopus* always agree with their females in palpal characters, their separation will be greatly facilitated.

(b). The thoracic segments.

If we take one of the more primitive chelate forms such as *Neochelogynus* and *Paranteon,* the thorax does not present any

striking peculiarities. The pronotum varies in length, but its hind angles always attain the tegulae; the usual divisions remain distinct, with well defined sutures. The thorax of the males throughout the whole family in general resembles that of these females. That the males should remain in this comparatively primitive condition may at first sight seem anomalous, but it is not really so, when one considers that the great modification of parts in the females of the highly evoluted forms is obviously entirely in connection with the habit of seizing and holding their prey, and not in any way due to sexual causes, such as would influence the other sex.

Turning to one of the most specialized winged forms, such as *Neodryinus,* we observe profound modifications of the thorax and of the front legs, the latter being lengthened in all their parts in a highly abnormal manner. The pronotum is remarkably elongate and further extension forwards (even to an increase of one-third the total length) is given by the development and dorsal position of other of the prothoracic elements. The pronotum itself is much narrowed behind and unusually mobile, but in spite of its great length the posterolateral angles fail to reach and are often very remote from the tegulae.

In the apterous forms such as *Pseudogonatopus* the thoracic sclerites attain the greatest modification of all. Here the mesonotum is reduced to a small narrow bridge between the pronotum and propodeum. Ashmead (Mon. Proct. p. 82) evidently mistook the pronotum of *Gonatopus* for the mesonotum, when he says "the latter" (i. e. mesothorax) "elongate and humped at the middle and separated from the metathorax by a strong constriction." This strong constriction is the mesonotum itself; and the great sclerite in front of it (often separated by an impression into two lobes) as is easily seen by comparing it with *Neodryinus* and other winged genera, is the mobile pronotum. The small, narrow, true mesonotum is usually without division, but in some forms of these apterous insects there is a very distinct posterior or scutellar division; and in some cases the mesonotum and its scutellum can easily be removed entire from the pronotum and propodeum. In some of these apterous forms, the lateral and sternal elements of the mesonotum become entirely fused with the propodeum, and no sutures at all remain by which the divisions may be distinguished.

(*c*). *The raptorial front legs.*

If we exclude a few genera of comparatively unspecialized, or

primitive form, the most striking character of the Dryinidae is the remarkable raptorial front tarsi of the females. These consist of the usual five joints, of which the fifth is always (and generally very greatly)abnormal, and together with one of the claws, which is always extraordinarily developed, forms a seizing and holding apparatus somewhat similar to that of a lobster's 'claw.'

In most of the forms one or two preceding joints are likewise somewhat modified, being more or less produced at the base beneath into a lamellate process.

In two of the genera here characterized, *Prosanteon* and *Paranteon*, the chelae are in their least specialized form, and the fifth tarsal joint is hardly abnormal, except that at the base it extends beneath the short preceding joint, and that the vestiture is somewhat modified. The strongly curved claw is simple, except for a tooth or angulation at or near the base beneath, and at rest is folded back on the fifth joint.

In all the genera with chelate tarsi the pulvillus is well-developed, the second claw is either quite small, or apparently in many forms altogether wanting; the great chelar claw being always folded back on the fifth tarsal joint when the insect walks or rests, and only extended when it is in the act of seizing the prey.

In *Neochelogynus* the chelae have advanced a stage in development. Not only is the armature or vestiture of the fifth joint often more perfect, but the point of articulation of the fourth has advanced far along the fifth, to almost, or beyond, the middle of the whole length of this joint. In consequence of this change in the point of articulation, the chelae are somewhat moveable, though still incapable of perfect forward extension. The claw of the chelae remains of the same form as in the just named genera.

In the higher genera the chelae are far more perfect. The articulation of the fourth is pushed forward nearly to the apex of the greatly elongated fifth, which lies beneath it when at rest; or, expressed in another way, there may be said to be a long free basal backward process to the fifth, the extremity of which forms with the tip of the developed claw the apex of the chelae, when these are extended. Thus when the chelae are in action the apparent apex of the fifth tarsal joint is morphologically its extreme base.

In all the higher forms dealt with in this paper the fifth tarsal joint, though differing in minor details, is in most respects similar. It is bent and somewhat dilated at its basal free extremity

and there very densely armed with the curious lamellate denticles or spines, which are so striking a character of the chelae generally. Its articulation with the fourth is of such a character as to afford extreme mobility and there is also an extremely perfect articulation between it and the great claw, allowing the most rapid closing and opening of this claw.

The claw itself, forming the one-half of the chelae, is worthy of careful study. In *Pseudogonatopus*, *Paragonatopus* and *Haplogonatopus*, of the apterous forms, it is, except for the bent tip, nearly straight and sub-parallel-sided, and always well armed with the lamellate denticles beneath. It has always in addition a minute, but quite distinct, tooth on its lower side, very close to the tip.

In *Gonatopus*, *Neogonatopus*, *Epigonatopus*, *Pachygonatopus* and *Chalcogonatopus* on the other hand, this claw is more curved, subdilated basally, with its lower edge on that part sharp and slightly convexly curved and the lamellate denticles are altogether absent or very inconspicuous and ill-developed.

Echthrodelphax, *Neodryinus*, *Paradryinus*, *Chlorodryinus*, and *Thaumatodryinus* in all essential respects resemble *Pseudogonatopus* and the two allied apterous genera.

Thus the genera with chelate tarsi form three groups:

(1). The chelae imperfectly extensile, the claw strong and nearly evenly curved, the lower edge nearly evenly concave; not armed beneath, except sometimes with a basal angulation or projection carrying a seta. The surface of the claw has a microscopic, longitudinal rugulose sculpture.

(2). The chelae are perfectly extensile, the claw is long, slender and less evenly curved, the curvature being chiefly on the apical third or half. The claw is subdilated basally, its lower edge not forming an even curve, but it is slightly convexly rounded on the basal half; lamellate denticles are altogether wanting or are very few and ill developed and more like mere setae, and there is no distinct microscopic tooth close to the apex. An almost imperceptible angulation is sometimes seen further back from the apex of the claw under strong magnification.

(3). The chelae are perfectly extensile; the claw long and slender and well armed beneath with lamellate denticles and with a small but quite distinct tooth near the apex; it is nearly straight and parallel-sided except that the tip is bent, and its lower margin on the basal half is not at all convexly curved, nor is the claw on that part subdilated.

Of the species considered in this paper the only real exception

to the above division is the remarkable new form called *Eukoebelcia*. This might form a separate division, having the chelar claw more curved, and armed apparently rather with serrations beneath, than with the ordinary lamellate structures, while the modified fifth tarsal joint also utterly lacks the usual armature and instead of being dilated at the extremity of its process is here narrowed into a curved hook.

As any one acquainted with the structure of the *Dryinidae* might guess from the abnormal character of this insect, its host is of a very special form, being none other than the anomalous *Bruchomorpha*.

Returning to the three primary divisions, it should be remarked that under the first are included all the forms with short, stout front legs and with large ovate stigma to the front wings and all the many species bred are absolutely confined to leaf-hoppers of the Jassid family, whether arboreal or subterrestrial.

Under the second are included only apterous species of *Gonatopus* and the four genera named above in connection with it, and all these are parasitic on Jassids, whether arboreal or subterrestrial.

The third, comprises all the other genera, of all of which we have bred species, and these are attached solely to Fulgorid leaf-hoppers either arboreal, or subterrestrial (i. e. graminivorous).

It is interesting to note that the first division which consists of the most primitive forms of Dryinidae are attached only to the less specialized Jassidae, while the varied and highly evoluted forms included under the third are restricted to the highly specialized Fulgoridae, the second section containing comparatively a few highly evoluted but always apterous forms that still remain attached to the Jassidae. Further it will be noted that the chelar claw of the first and second divisions comprising parasites of Jassids only, is always of different form and differently armed from those of the third, which are parasites of Fulgorids. and as far as our researches go, a Jassid parasite can immediately be distinguished from that of a Fulgorid by an examination of the claw alone.

THE NATURAL POSITION OF THE DRYINIDAE.

The Dryinidae are treated by Ashmead in his later classifications as a sub-family of the Bethylidae, the latter being included in the super-family Vespoidea. In placing the insects in the Aculeate series he reverts to Haliday's classification of 1839,

while in his Monograph of the North American Proctotrupidae (1893) he agreed with Westwood and Forster in placing them in the Proctotrupids, seeing a relationship with the Ceraphroninae, which are still left in the Proctotrupidae.

The super-family Vespoidea of Ashmead appears to me an unnatural assemblage of forms, and by no means comparable with, or equivalent to, the very natural series comprised under the Apoidea and Sphegoidea. It is very doubtful whether the old classification into Anthophila, Fossores and Diploptera is any way improved by the severance of one main division of the Fossores and by its addition to the Diploptera, to which are also added the Bethylidae, Dryinidae and Chrysididae, etc., to form a super-family.

If we examine the characters laid down for the separation of the super-family Vespoidea, we find that this depends on the fact of the "pronotum extending back to the tegulae, or the latter absent." Yet in great numbers of winged female Dryinids the pronotum does not extend back to these, and in great numbers of the Chrysididae the hind angles of the pronotum not only do not attain, but are quite remarkably distant from, the tegulae.

As therefore the Bethylidae (incl. Dryinidae) and the Chrysididae do not fall naturally into one great super-family with the Vespidae, and can only be placed therein by disregarding the characters assigned to the Vespoidea, it seems to me better to recognize this fact. Of course by employing alternatives, such as the character of the abdominal segments, etc., for the Chrysididae and the chelate tarsi of the Dryinidae, these families might be made to fit in the Vespoid series, or anywhere else for that matter, yet such a procedure will hardly carry conviction to the majority of hymenopterists.

To me the Dryinidae together with the allied Bethylidae and the small and little known sub-family Emboleminae* of Ashmead (which may probably be merged in one or other of these) constitute a natural group, synthetic between the old Fossorial series of the Aculeata and the true Proctotrupidae; while the Chrysididae also constitute a group apart, which cannot be rightly merged in the Bethylid series, nor yet in the Aculeata.

Dr. Ashmead considers the Dryinidae as "evidently an ancient phylogenetic type of the order, the chelate anterior tarsi in the

* My knowledge of this sub-family is acquired from Ashmead's standard work on the Proctotrupids of North America, and from an undescribed insect which I refer to this group, though its structures will necessitate changes in the characters assigned to the Emboleminae. The larva is an external parasite of small crickets of the genus Trigonidium or allied forms, and like the Dryinidae leaves the several larval skins behind, as a ruptured sac, after the penultimate larval ecdysis.

females being found in no other group afong the Hymenoptera" (Mon. N. A. Proct. p. 81). I am unable to see in what possible way the remarkable and highly evoluted form of the front legs can in any way affect this matter, for, surely, it has no phylogenetic significance, being in no way homologous with the chelate legs of other orders of insects. Moreover, in existing species of the Dryinidae we can clearly see how the highly modified chelate tarsus of such a form as *Dryinus* or *Gonatopus* has arisen within the limits of the family from the simple non-chelate tarsus of such a form as *Aphelopus*. It is from these simple forms that the affinities of the Dryinidae must be judged.

SYSTEMATIC ACCOUNT OF THE DRYINIDAE.

The following list comprises all the species specially considered in this paper, and I may add that the species first described in each new genus is to be considered as the type of that genus. It will be observed that the generic characters are all drawn up from female examples, although I have added a short table of characters that distinguish the males in a considerable number of genera. Similarly in only a few cases are the males of the various species described, in fact only in those cases, where there is no doubt whatever that they are rightly assigned to their partners. Where one sex only is described, it is always the female; where both sexes are described, that of the male always follows the description of the female. Had I cared to describe males, which cannot at present be certainly associated with their females, the list of new species would have been greatly increased, but it would have served no useful purpose to do this, since in many cases the males of species, most distinct in the other sex, are hardly separable specifically.

In the list, all species marked with an asterisk have had the mouth parts dissected and examined in balsam; others have had them, totally or partially dissected out, and examined dry; while some from their very close relationship to other species I have not thought it necessary to examine thus minutely.

PSEUDOGONATOPUS, g. nov.

1. P. kurandae, sp. nov.*
2. P. juncetorum, sp. nov.
3. P. palustris, sp. nov.*
4. P. saccharetorum, sp. nov.
5. P. dichromus, sp. nov.*
6. P. americanus, sp. nov.*
7. P. opacus, sp. nov.
8. P. stenocrani, sp. nov.*
   var. dubiosus, var. nov.

HAPLOGONATOPUS, g. nov.

9. H. apicalis, sp. nov.*
10. H. moestus, sp. nov.
11. H. americanus, sp. nov.*

PARAGONATOPUS, g. nov.

12. P. nigricans, sp. nov.*

GONATOPUS Ljung.

13. G. australiae, sp. nov.*

NEOGONATOPUS, g. nov.

14. N. ombrodes, sp. nov.*
15. N. erythrodes, sp. nov.*
16. N. obscurissimus, sp. nov.
17. N. pulcherrimus, sp. nov.
18. N. dubiosus, sp. nov.
19. N. brunnescens, sp. nov.
20. N. pallidiceps, sp. nov.

EPIGONATOPUS, g. nov.

21. E. solitarius, sp. nov.*

PACHYGONATOPUS, gen. nov.

22. P. melanias, sp. nov.*

CHALCOGONATOPUS, g. nov.

23. C. gigas, sp. nov.*
24. C. optabilis, sp. nov.*
25. C. decoratus, sp. nov.*

EUGONATOPUS, subg. nov.

26. E. pseudochromus, sp. nov.*

ECHTHRODELPHAX, Perk.

27. E. fairchildii, Perk.*
28. E. nigricollis, sp. nov.
29. E. bifasciatus, sp. nov.

NEO~~GONATOPUS~~, g. nov. Dryinus

30. N. koebelei, sp. nov.*
31. N. nelsoni, sp. nov.
32. N. raptor, sp. nov.
    var. umbrata, var. nov.

PARADRYINUS, g. nov.

33. P. koebelei, sp. nov.*
34. P. venator, sp. nov.*
35. P. threnodes, sp. nov.
36. P. gigas, sp. nov.
37. P. leptias, sp. nov.
38. P. varipes, sp. nov.

CHLORODRYINUS, g. nov.

39. C. pallidus, sp. nov.

THAUMATO-DRYINUS, g. nov.

40. T. koebelei, sp. nov.

EUKOEBELEIA, gen. nov.

41. E. mirabilis, sp. nov.*

NEOCHELOGYNUS, g. nov.

42. N. typicus, sp. nov.
43. N. nitidus, sp. nov.
44. N. leiosomus, sp. nov.
45. N. dimidiatus, sp. nov.
46. N. nigricornis, sp. nov.*
47. N. destructor, sp. nov.*
48. N. cognatus, sp. nov.
49. N. parvulus, sp. nov.
50. N. coriaceus, sp. nov.
51. N. pallidicornis, sp. nov.

PROSANTEON, g. nov.

52. P. chelogynoides, sp. nov.*

PARANTEON, g. nov.

53. P. myrmecophilus, sp. nov.*

SYNOPSIS OF GENERA OF DRYINIDAE.

Females.

1. (41) Tarsi of front legs with the fifth joint always more or less modified and with one claw greatly developed and capable of closing back on the fifth joint, so as to form more or less perfect chelae or pincers.

2. (18) Mesonotum forming a narrow bridge or stalk between the large pronotum and propodeum. Species wingless.

3. (4) Maxillary palpi 5-jointed........ *Gonatopus Ljungh.*

4. (3) Maxillary palpi not 5-jointed.

5. (10) Chelar claw armed conspicuously with special denticles similar to those on the fifth tarsal joint beneath, its lower margin nearly straight on the basal half, not with a sharp subconvex edge.

6. (9) Pronotum with a conspicuous transverse impression before the middle, dividing it into a shorter anterior and longer posterior lobe.

7. (8) Maxillary palpi 4-jointed..........*Pseudogonatopus*

8. (7) Maxillary palpi 2-jointed............ *Paragonatopus.*

9. (6) Pronotum without a distinct transverse impression (maxillary palpi 2-jointed).......*Haplogonatopus.*

10. (5) Chelar claw more curved, usually with few or no denticles beneath, or at most with very inconspicuous ones, which are absent from the apical part, the lower edge on the more basal part slightly convexly curved, so that the claw is much less parallel-sided than that of the preceding three genera.

11. (16) Maxillary palpi not 6-jointed.

12. (15) Anterior trochanters very long, with a longish thin basal stalk; head above very distinctly concave from eye to eye.

13. (14) Maxillary palpi 4-jointed............ *Neogonatopus.*

14. (13) Maxilary palpi 2-jointed............*Epigonatopus.*

15. (12) Anterior trochanters stout, not very elongate, widening from the base, so that there is no long narrow basal portion; head above not distinctly concave from eye to eye. (Maxillary palpi 3-jointed, the basal excessively small).........*Pachygonatopus.*

16. (11) Maxillary palpi 6-jointed..........*Chalcogonatopus.*

17-a. (17-b.) A distinct suture or impression extending forwards from the middle coxae and dividing the propodeum from the mesothoracic elements......... ....*Chalcogonatopus s. s.*

17-b. (17-a.) (b) No such suture visible, the propodeal and mesothoracic elements fused laterally............ ....subg. *Eugonatopus.*

18. (2) Mesonotum of ordinary form, species fully winged or with rudimentary wings.

19. (28) Posterior lateral angles of the pronotum not nearly attaining the tegulae.

20. (21) Maxillary palpi very short, 4-jointed, basal joint very small, the entire palpi capable of being concealed within the buccal cavity; parapsidal furrows very distinct, meeting posteriorly so as to enclose a narrow elongate triangular area. . .*Echthrodelphax P.*

21. (20) Maxillary palpi long and conspicuous reaching back at least beyond the middle of the head, if laid at full length along the middle line, and generally reaching to its hind-margin or behind this.

22. (25) Vertex of head slightly concave or impressed, never convex.

23. (24) Labial palpi 2-jointed, mandibles 3-dentate, (sec. Ashmead (Mon. Proctotryp.)..........*Dryinus Latr.*

24. (23) Labial palpi 3-jointed, mandibles 4-dentate, parapsidal furrows entirely wanting............*.Neodryinus.*

25. (22) Vertex of head not impressed or concave.

26. (27) Occipital concavity well and distinctly margined even at the sides.......................*Paradryinus.*

27. (26) Occipital concavity with a very faint margin behind the ocelli, which fails at the sides . .*Chlorodryinus.*

28. (19) Pronotum attaining the tegulae posteriorly.

29. (32) Stigma elongate and narrow, generally lanceolate, not wide and ovate, or the wings are abbreviated and rudimentary.

30. (31) Wings fully developed, antennae extremely long and thin, filiform, head short on the vertex, more than twice as wide as long......... *Thaumatodryinus.*

31. (30) Wings minute, rudimentary (mandibles 3-dentate, maxillary palpi 6-jointed, eyes conspicuously hairy) .... *Eukoebelcia.*

32. (29) Stigma large of ovate or subovate form, and the wings fully developed.

33. (36) Fourth joint of front tarsi elongate, much longer than the third, and articulated to the fifth at a distance from the true apex (or insertion of the pulvillus) of ½ to ⅓ the length of the whole joint.

34. (35) Maxillary palpi 5-jointed; propodeum long, rounded posteriorly (sec. Ashmead Mon. Proct.).......... ....*Chelogynus Hal.*

35. (34) Maxillary palpi 6-jointed......... . .*Neochelogynus.*

36. (33) Fourth joint of front tarsi small and short, not differing much from the third, and articulated far from the true apex of the fifth, so that the latter is almost normal being only slightly produced beneath in front of its articulation with the fourth.

37. (38) Maxillary palpi 4-jointed, labial palpi 2-jointed, mandibles 3-dentate (sec. Ashmead Mon. Proct.).......................................*Anteon Jur.*

38. (37) Maxillary palpi 6-jointed, labial palpi 3-jointed, mandibles 4-dentate.

39 (40) Antennal joints widening more or less towards the apex of the antennae; propodeum bounded by a raised line at the truncature and with a definite median area on its posterior face... ..*Prosanteon.*

40. (39) Antennae simply filiform, not at all widening towards apex; propodeum without the above characters...*Paranteon.*

41. (1) Tarsi of front legs simple, not chelate.

42. (43) Apterous; maxillary palpi 4-jointed (sec. Ashmead Mon. Proct.).............. .*Mystrophorus* Forst.

43. (42) Winged; maxillary palpi 5-jointed (sec. Ashmead Mon. Proct.)..................*Aphelopus* Dalm

Males.

1. (14) Stigma not large and ovate or subovate, but narrow lanceolate; mandibles with three teeth.

2. (5) Maxillary palpi very short and inconspicuous, labial palpi two-jointed.

3. (4) Antennae sometimes long, but never extremely thin and filiform; the head not incrassate...................... *Gonatopus* (and most of the allied genera).

4. (3) Antennae extremely thin and long, the head incrassate......................... *Echthrodelphax.*

5. (2) Maxillary palpi long and conspicuous, reaching at least to the posterior margin of the head, if laid straight back; labial palpi three-jointed.

6. (9) Ocelli in a slightly curved line on the vertex, the front ocellus, at most, a very little in front of the posterior pair.

7. (8) Basal cells not indicated by distinct nervures...*Chalcogonatopus.*

8. (7) Basal cells distinct, even though the neuration be pallid..............................*Neodryinus.*

9. (6) Ocelli in a well-marked triangle, the front one well in advance of the posterior.

10. (11) Eyes not hairy......................*Chlorodryinus.*

11. (10) Eyes distinctly hairy.

12. (13) Antennae with long flagellar joints, the third not less than four times as long as wide......*Paradryinus.*

13. (12) Antennae with short flagellar joints, the third not or hardly twice as long as its greatest width..*Eukoebeleia.*

14. (1) Stigma large, ovate or subovate, mandibles with four teeth.

15. (16) Antennae with short flagellar joints, which are not twice as long as wide.............*Neochelogynus.*

16. (15) Antennae with elongate moniliform joints, which are contracted at base and apex and fully twice as long as wide..............................*Paranteon.*

PSEUDOGONATOPUS, gen. nov.

Apterous, general form that of *Gonatopus*, the mesonotum very small and narrow, forming a stalk between the large pronotum and propodeum.

Vertex of head quite deeply concave, third joint of antennae much longer than the fourth; labial palpi two-jointed, maxillary palpi four-jointed (counting the extremely short basal joint) with two joints beyond the geniculation; mandibles with four teeth, the two inner minute. Front legs with very long, clavate trochanters, which have a long thin basal portion; fourth tarsal joint very long, several times as long as the preceding joint; claw of chelae armed beneath with special denticles similar to those beneath the modified fifth tarsal joint, bent near the apex and the lower edge with a small anteapical tooth, otherwise nearly straight and subparallel-sided, the lower margin on the basal half nearly straight, not convexly curved. Pronotum with a deep transverse impression before the middle.

Synopsis of Species of PSEUDOGONATOPUS.

1. (8) Propodeum without conspicuous pilosity.
2. (5) Propodeum ferruginous or testaceous.
3. (4) Propodeum shining, third joint of antennae not longer than the scape. . . . .*P. dichromus.*
4. (3) Propodeum not shining; third joint of antennae longer than the scape. . . . .*P. americanus.*
5. (2) Propodeum black (with very dense coriaceous or microscopically rugulose sculpture).
6. (7) Intermediate and posterior femora and tibiae dark, black or piceous. . . . .*P. opacus.*
7. (6) Intermediate and posterior femora and tibiae pale, yellowish brown to testaceous.

7a. (7b) Tip of antennae conspicuously pale. .*P. stenocrani.*

7b. (7a) Tip of antennae black. . . . . *P. dubiosus,* var. praec.

8. (1) Propodeum with conspicuous pilosity.
9. (10) Propodeal elevation strongly channeled in the middle and prominent on either side of the channel. . . . . *P. junccetorum.*
10. (9) Propodeum behind the spiracles at most a little flattened or concave, not fissured so as to form two prominences.
11. (12) Propodeum in dorsal aspect with prominent anterior lateral angles. . . . .*P. kurandae.*
12. (11) Propodeum without prominent anterior lateral angles.
13. (14) Mesonotum conspicuously pallid . .*P. saccharetorum.*
14. (13) Mesonotum not conspicuously pallid, concolorous with the rest of the thorax or nearly so *P. palustris.*

1. *Pseudogonatopus kurandae,* sp. nov.

Brown, the abdomen black or nearly so, the face, the propodeum in front and posteriorly above the petiole, pale yellowish brown or testaceous; the two basal and the apical antennal joint quite pale, tibiae and tarsi testaceous, the front tibiae more or less brown.

Head smooth, shining, posteriorly with fine and rather long hairs, third antennal joint long and slender, fully twice as long as the second, longer than the scape and much longer than the

Vertex of head only slightly shining; third joint of antennae very long and slender, more than twice as long as the second, the apical joint black or almost so. Pronotum not very shining, and like other parts of the thorax more or less suffused or marked with black; mesonotum in the middle paler than the rest of the thorax; propodeum very strongly raised or convex, the surface dull, but with hardly visible sculpture on the middle behind the spiracle, posteriorly transversely strigose. Abdomen smooth impunctate, apparently glabrous. Length 3-3.5 mm.

Hab. Columbus, Ohio, U. S. A. (Koebele).

Pseudogonatopus opacus, sp. nov.

Black or pitchy, the face below the antennae, the two basal joints of these more or less, the anterior tibiae and tarsi, testaceous. The posterior tarsi and part of the apical joint of the antennae more or less, pale-coloured.

Dull, the head densely and minutely sculptured, appearing punctured, as also the whole of the thorax, even the posterior face of the propodeum with this sculpture instead of the usual transverse rugosity, and without evident pilosity. Abdomen smooth and shining and bearing short pale hairs. Length 2-3 mm.

Var. a. (?immature) Paler, more pitchy than black with the hind and middle tarsi quite pale and the apical joint of the antennae much more distinctly so than in the type.

Hab. Bundaberg and Brisbane, Queensland; bred.

8. *Pseudogonatopus stenocrani*, sp. nov.

Vertex of head dark, face and occiput pale, varying from ferruginous to yellowish white. Antennae with the two basal, sometimes the third, the apical, and one or two of the preceding joints more obscurely, pale. Pronotum ferruginous or brown, often more or less suffused or marked with black; propodeum black; legs testaceous, the front femora and tibiae especially, more or less dark brown.

Head and pronotum with extremely fine hardly visible punctures, or surface sculpture; the propodeum with extremely dense microscopic sculpture, appearing like fine and dense puncturation, but due really to reticulation of the surface as in the preceding species. In profile the propodeum is not at all abruptly

humped and posteriorly bears at most a few short and inconspicuous hairs. Length 2-3 mm.

Hab. Ohio, U. S. A. (Koebele).

P. stenocrani var. dubiosus var. nov.

Like the typical form in structure but without the pale tips to the antennae.

Hab. Ohio, U. S. A. (Koebele).

HAPLOGONATOPUS, gen. nov.

Mandibles, maxillary and labial palpi, and the front legs practically as in the preceding genus, but the pronotum is very different, not being divided into a transverse anterior and elevated posterior portion, being quite simply convex, and the head is much more deeply concave.

Synopsis of Species of HAPLOGONATOPUS.

1. (4) Thorax for the most part dark-coloured or black.
2. (3) Apical joint of the antennae and the mesonotum largely, pale........................*H. apicalis.*
3. (2) Apical joint of the antennae and the mesonotum dark ....*H. moestus.*
4. (1) Thorax ferruginous or testaceous, at most a little infuscate ....*H. americanus.*

1. *Haplogonatopus apicalis*, sp. nov.

Black or more or less pitchy, the face on its lower half, the two basal, and sometimes the third antennal joint more or less, the apical joint, and sometimes more or less of the preceding, the mesonotum for the most part, and the legs (which are, however, often largely brown), pale, yellow to testaceous. Pronotum and propodeum posteriorly sometimes brown.

Antennae with the third joint long and slender, about twice as long as the second, the head above with scarcely visible sculpture. Pronotum very smooth, shining; mesonotum conspicuously pale; propodeum in front of the spiracles very finely transversely rugulose, behind these smooth and shining, posteriorly more or less distinctly transversely rugulose and without evident

pilosity. Abdomen smooth, shining, glabrous. Length 2-2.5 mm.
Hab. Bundaberg and Childers, Queensland; bred.

2. *Haplogonatopus moestus*, sp. nov.

Apparently identical structurally with the preceding, but the apical joint of the antennae is not pale, nor does the mesonotum differ greatly from the rest of the thorax in colour, and consequently the two forms are very easily distinguished by colour characters, which appear to be of specific importance.
Hab. The Mulgrave near Cairns, Queensland; bred.

3. *Haplogonatopus americanus*, sp. nov.

Ferruginous to testaceous in colour ,the abdomen black, or obscurely pallid, changing much during life in some individuals. The antennae black, the apical joint and the two or three basal ones pale. Head generally brown on the vertex, parts of the thorax also sometimes more or less darkened.

Head with scarcely visible sculpture; pronotum shining, the transverse impression just perceptible at least at the sides in some examples, very minutely, in fact hardly perceptibly, punctured; propodeum dull, with microscopic surface rugulosity, and not at all pilose. Abdomen smooth, glabrous. Length about 2.5 mm.

Hab. Columbus, Ohio, U. S. A. (Koebele and Swezey). Mr. Swezey was of the opinion that this species was *Gonatopus bicolor* Ashmead, but that species has the "metathorax smooth, polished." I have bred about 150 females of *H. americanus* without apparent variation.

PARAGONATOPUS, gen. nov.

Head evidently, but only lightly, concave on the vertex; third joint of antennae very long (about twice as long as the fourth in the typical species). Mandibles 4-dentate, maxillary palpi only two-jointed, one elongate joint beyond the geniculation and apparently only one before this, the extremely short basal joint, that is present in allied genera, being apparently absent. Trochanters of front legs, as well as the tarsi and claw of chelae and the form of the pronotum, etc., as in the preceding genus.

Paragonatopus nigricans, sp. nov.

Black, the face below the antennae pale, the vertex of the head usually brown, sometimes piceous or nearly black, two basal joints of the antennae entirely or largely, the third sometimes more or less, pale. Legs generally to a large extent obscure brown or piceous, all the tarsi and trochanters and the hind tibiae pale yellowish brown or testaceous, but the legs vary in colour.

Head above more or less shining, and hardly perceptibly sculptured; the antennae slender, the third joint thin and elongate, about three times as long as the second, and almost twice as long as the fourth. Pronotum shining, its posterior lobe finely punctured, the propodeum finely transversely rugose in front and posteriorly, between these parts smoother, and usually finely punctured, sometimes impunctate, not pilose. Abdomen smooth, shining, almost or quite glabrous. Length 2.5-3 mm.

Hab. Bundaberg, Queensland; bred.

? GONATOPUS Ljungh.

Mandibles 4-dentate, maxillary palpi five-jointed, the basal joint extremely short and with three joints beyond the geniculation, labial palpi two-jointed. Vertex of head deeply concave; antennae with the third joint long, slender, from one-third to one-half longer than the fourth.

Pronotum deeply impressed, so as to be divided into a transverse anterior and elongate narrow posterior lobe. Front legs with trochanters very long, clavate, with long thin basal stalk; fourth tarsal joint very long, differing not much in length from the basal one, chelar claw curved, subdilated on its basal portion, and with the lower edge slightly convexly curved, and these armed at most with a few very inconspicuous denticles or spinose hairs.

Gonatopus australiae, sp. nov.

Black, the head, the thorax excepting the propodeum, brown or ferruginous. The face generally paler than the vertex of the head, the front lobe of the pronotum sometimes dark, propodeum rarely more or less of an obscure reddish black. Scape of antennae in front quite pale, the following two joints, or one of them, sometimes more or less so, the apical joint black, the legs with pale tibiae and tarsi, the femora generally largely brown or dark.

Head very deeply concave above, smooth and shining and fringed behind with longish hairs; the antennae slender, with long thin third joint, about one and a half times as long as the fourth. Pronotum smooth and shining; mesonotum rugulose; propodeum shining, traversely rugose behind, and thinly clothed with long pale hairs. Abdomen smooth and shining, at the base with some erect pale hairs, elsewhere glabrous. Length 2-3 mm.

Hab. Bundaberg, Queensland; bred.

NEOGONATOPUS, gen. nov.

Differs from Gonatopus, as characterized above, only by the 4-jointed maxillary palpi, there being two not three joints beyond the geniculation.

Synopsis of Species.

1. (4) Propodeum without hairs, and entirely black.
2. (3) Head, neck, and anterior margin of pronotum ferruginous, or pale yellowish brown; rest of thorax and abdomen deep black. . . . . *N. pallidiceps.*
3. (2) Head above dark brown or blackish, or largely suffused with dark colour. . . . . *N. ombrodes*
4. (1) Propodeum with distinct erect hairs; sometimes ferruginous, wholly or in part.
5 (6) Whole thorax ferruginous; tip of antennae white. . . . . *N. pulcherrimus.*
6. (5) Propodeum at least (and sometimes most of the thorax) more or less dark; tip of antennae not white.
7. (8) Propodeum dark brown, generally paler anteriorly; head above only lightly concave. . . *N. brunnescens.*
8. (7) Propodeum black; head above strongly concave.
9. (10) Whole pronotum and the neck in front of this clear ferruginous; propodeum dull, with very dense sculpture. . . . . *N. erythrodes.*
10. (9) Pronotum mostly black, piceous, or dark brown; if in part it is rather distinctly red or ferruginous, then the propodeum is polished and very shining.
11. (12) Abdomen on its basal face with conspicuous erect hairs; propodeum highly polished. . . . *N. dubiosus*
12. (11) Abdomen on its basal face without long erect hairs; propodeum not highly polished . . *N. obscurissimus.*

1. *Neogonatopus ombrodes*, sp. nov.

Black, the vertex of the head, and the pronotum (more or less) often piceous or brown; face and occiput yellow or ferruginous; basal two, and sometimes the third joint of the antennae more or less, pale; legs pale yellowish brown or testaceous, in parts often dark brown, variable in colour.

Head rather long, very much longer than half its width, and owing to a very minute puncturation or surface sculpture little, or not at all, shining; third joint of antennae long and slender, twice as long as the second. Pronotum with close and very fine punctures or surface sculpture; propodeum dull and very densely sculptured, appearing punctate, but probably with dense microscopical reticulate sculpture of the surface, which is hairless, or almost on. Abdomen smooth, shining, glabrous, no longish hairs basally. Length 3-3.5 mm.

Hab. Columbus, Ohio, U. S. A. (Koebele).

2. *Neogonatopus erythrodes*, sp. nov.

Ferruginous, the propodeum black, the abdomen probably black when the insect first emerges, but becoming testaceous more or less suffused with black or brown, as it grows older; head above more or less dark, the antennae black, with the three basal joints pale. All the legs yellowish-brown, or testaceous.

Head above somewhat shining, not nearly twice as wide as long; pronotum shining and with a very fine indefinite punctuation; propodeum dull, having the same dense sculpture as in the preceding species, but with the whole of the posterior face distinctly transversely rugose, and bearing scanty but distinct, erect hairs. Abdomen smooth, shining, shortly pilose. Length about 3 mm.

Hab. Columbus, Ohio, U. S. A. (Koebele).

3. *Neogonatopus obscurrissimus*, sp. nov.

Black, in parts (especially the pronotum, mesonotum and some of the leg joints) dark brown or piceous. Basal two and more or less of the third joint of the antennae, as well as all the tarsi, and more or less of the hind tibiae and femora, pale, yellowish or testaceous.

Head shining and with a sparse fringe of hairs posteriorly; pronotum smooth and shining, hardly perceptibly sculptured; pro-

podeum in some aspects somewhat shining in some parts, above with minute dense surface scultpure, and posteriorly finely transversely rugose, and bearing evident, longish, erect hairs. Abdomen very smooth and shining, sparsely pilose. Length about 3 mm.

Hab. Columbus, Ohio, U. S. A. (Koebele).

4. *Neogonatopus pulcherrimus,* sp. nov.

Ferruginous, the abdomen black. Antennae black with the three basal, and the fourth joint more or less, testaceous, the apical one white.

Head above very smooth and shining, and fringed posteriorly; the antennae thick, the joints from the fourth on being unusually short and wide. Pronotum very smooth, and shining, the mesonotum less narrow than usual; the propodeum smooth and shining, very conspicuously pilose, and on the posterior face finely transversely rugose. Abdomen smooth, shining, at the base conspicuously pilose. Length about 3 mm.

Hab. Bundaberg, Queensland; bred.

5. *Neogonatopus dubiosus,* sp. nov.

Black, shining, head above usually dark brown or brown, the face paler; basal or two basal antennal joints pale, as also the greater part of the legs; posterior lobe of the pronotum and the mesonotum nearly always dark, black or pitchy.

Form, sculpture and clothing identical with that of *Gonatopus australiae* but with the pronotum and mesonotum nearly always, if not invariably, less red, and with only two joints beyond the geniculation of the maxillary palpi. Length 2.5-3 mm.

Hab. Bundaberg, Queensland; bred.

6. *N. brunnescens,* sp. nov.

Largely brown or yellowish-brown, the abdomen sometimes black or dark brown, sometimes sordid testaceous, variable, no doubt changing colour with age; propodeum posteriorly dark brown or pitchy. Basal two joints of the antennae and the third less clearly, as well as all the legs, pale-coloured.

Head in front view very little concave on the vertex, smooth and shining above; propodeum more or less smooth and shining, sparsely clothed with erect and not very long, bristly hairs, which

extend on to the mesonotum, but are easily abraded. Abdomen smooth, shining, sparsely pilose, if not abraded. Length 2.5-3 mm.

The much less deeply concave head distinguishes this species from any other here described in this genus.

Hab. Ohio, U. S. A. (Koebele): bred.

7. *N. pallidiceps,* sp. nov.

Head, apical margin of the pronotum, and the neck in front of it, the three basal antennal joints, and all the legs, pale, yellow or ferruginous.

Head smooth, shining; pronotum also smooth and shining and extremely finely punctured; propodeum a little shining in some aspects, the whole dorsal surface with minute surface sculpture and with a few short microscopic hairs; posteriorly very finely transversely rugose. Abdomen deep black, smooth and shining. Length about 2.5 mm.

Hab. Alameda, California, U. S. A.; bred.

EPIGONATOPUS, gen. nov.

Front legs and pronotum as in the two preceding genera, but the maxillary palpi quite different, two-jointed, one long acuminate joint beyond the geniculation.

Epigonatopus solitarius, sp. nov.

Thorax ferruginous, abdomen for the most part black, legs, two basal, and more or less of the third joint of the antennae, as well as the whole face, pale, yellowish or testaceous. Front femora (except at the apex) at least, and sometimes other parts of the legs, dark brown, black or piceous. Vertex of head dark.

Head above, smooth and shining, and without definite sculpture. Pronotum smooth, minutely punctured, and more or less longitudinally rugulose; propodeum at most somewhat shining about, or before, the middle; in front with rugulose surface, and posteriorly quite distinctly, but finely transversely rugose, not pilose. Abdomen smooth, shining, without hairs. Length about 3 mm.

Hab. Bundaberg, Queensland; captured, not bred.

PACHYGONATOPUS, gen. nov.

Head with the vertex incrassate, a little impressed in the mid-

dle; in front aspect not evidently concave from the one eye-margin to the other; mandibles 4-dentate; maxillary palpi 3-jointed, the basal joint excessively short, a single elongate joint beyond the geniculation. Anterior trochanters not very elongate, clavate, thickening from close to the base, and not with a long slender stalk like all the preceding genera. Otherwise the front legs are much as in the three preceding genera, which this genus resembles also in other respects.

Pachygonatopus melanias, sp. nov.

Black, the face below the antennae, the two basal joints of these (which are however darker above), all the tibiae and tarsi, but especially the front pair, pale.

Head above, very shining, with some indefinite impressions, and a median distinct one extending forwards from the front ocellus; the face above the antennae dull and very densely and minutely sculptured. Pronotum very shining, and with indefinite puncturation; propodeum shining, the surface sculpture very delicate, appearing like dense minute puncturation, not transversely rugose, nor pilose posteriorly. Abdomen smooth and shining. Length 2-2.5 mm.

Hab. Bundaberg and Rockhampton, Queensland; bred.

CHALCOGONATOPUS, gen. nov.

Apterous, head concave above, the antennae slender and elongate, with long, thin third joint. Mandibles quadridentate; maxillary palpi with six joints, labial palpi three-jointed. Pronotum deeply, transversely impressed before the middle, to form a short wider anterior and a narrow, long, elevated, posterior division; the whole thorax in fact formed much as in *Gonatopus* and its allies. Fourth joint of anterior tarsi very long about equal to the basal one, chelar claw as in *Gonatopus*. Thorax laterally with a very distinct groove or suture running forwards from the middle coxae and marking off the propodeal and mesothoracic elements.

EUGONATOPUS subgen. nov.

A very distinct subgenus of the above, having the joints of the flagellum of the antennae less long and slender, and the propodeal and mesothoracic elements, at the sides of the thorax posteriorly, completely fused.

1. *Chalcogonatopus gigas* sp. nov.

Black, slightly aeneous, especially the abdomen, the whole body and the legs clothed with conspicuous erect hairs. Clypeus, mandibles, two basal joints of the antennae, the front tarsi except the basal joint, the front coxae and trochanters, the middle and posterior tarsi, more or less pale, yellowish or testaceous. Sometimes other parts of the legs are pale, the species being variable. Antennae long and slender, the fourth joint much longer than the scape, the sixth three or four times as long as wide, the third conspicuously longer than the fourth. Head dull, with extremely dense, minute puncturation or surface rugulosity; the thorax with similar sculpture, the propodeum in front and posteriorly with transverse rugosity also. Abdomen very dull and with feeble scattered punctures, from which the erect hairs arise. Length 5-7 mm.

Hab. Bundaberg, Queensland; bred.

2. *Chalcogonatopus optabilis* sp. nov.

Nigroaeneous, with white pubescence, the face below the antennae, the two basal joints of the antennae, the front tibiae and tarsi, and the posterior and intermediate tarsi more or less, pale-coloured, yellowish or testaceous.

Head for the most part smooth and shining above, but near the hind-margin of the eye densely punctulate; the antennae long and slender, none of the flagellar joints being less than twice as long as wide, the scape hardly as long as the fourth antennal joint, and the third much longer than the latter. Thorax pubescent, dull, or hardly shining; the pronotum indefinitely punctured; the propodeum with excessively fine transverse rugulosity, when seen under a compound microscope, and visible with a strong lens. Abdomen with rather short, white, appressed hairs. Legs without erect hairs. Length 3-4 mm.

Hab. Bundaberg, Queensland; bred.

3. *Chalcogonatopus decoratus,* sp. nov.

Like the preceding in the nigroaeneous colour, but with the antennae rather less slender, the scape, being as long as the fourth joint. The clothing is quite different, consisting of grey tomentosity, whereas in the preceding, especially on the abdomen, the individual hairs are very apparent. The pronotum is red at the sides and posteriorly, and bears a distinct median

carina; the fine sculpture of the propodeum is extremely dense. The abdomen is extremely densely and minutely punctured. Length about 3 mm.

Hab. Bundaberg, Queensland; bred.

4. *Chalcogonatopus (Eugonatopus) pseudochromus*, sp. nov.

Ferruginous or more or less testaceous, the propodeum, and head above, black or dark; basal two joints of antennae quite pale, the following less clearly so, the rest black or fuscous.

Antennae less slender than in any of the preceding, scape as long as the fourth joint, seventh, eighth and ninth not twice as long as wide. Head dull, appearing densely and minutely punctate, the pronotum with very similar sculpture; the propodeum in front and posteriorly finely transversely rugose, in the middle sculptured like the head, not pilose nor pubescent; at the sides without any suture or impression dividing off the mesopleural region. Abdomen smooth, without pubescence or pilosity, the base black, and elsewhere more or less stained with fuscous. Legs neither pilose nor pubescent. Length about 4 mm.

Hab. Columbus, Ohio. (Koebele).

ECHTHRODELPHAX P.

(Bull. I., Div. Ent., Board Agr. & For., Territory of Hawaii).

Head above concave or impressed, and the face in front view strongly transverse, of triangular shape, and very similar to that of *Neodryinus*. Ocelli in a triangle of very elongate isosceles form, the front one very distant from the two basal ones, which are near together. Maxillary palpi short, four-jointed, labial palpi two-jointed. Mandibles quadridentate. The mouth parts in fact are practically as in *Pseudo-gonatopus*, as also is the pronotum, which has a distinct transverse impression. Mesonotum wider than the pronotum, shaped like that of *Neodryinus*, and with no resemblance to that of *Gonatopus*, etc., the parapsidal furrows quite distinct, enclosing a very narrow, median, elongate, triangular area. Wings fully developed, and with the usual neuration of the group. Front legs and chelae practically as in *Pseudogonatopus*.

Male with the short palpi of *Pseudogonatopus*, etc., but the extremely long, thin, filiform antennae and the subincrassate head will easily distinguish it generically, as also from any of the other allied genera with apterous females.

Table of species of ECHTHRODELPHAX.

1. (4) Thorax entirely, or all but the pronotum, black; wings without transverse bands.
2. (3) Pronotum yellow..................*E. fairchildii P.*
3. (2) Pronotum black...................*E. nigricollis.*
4. (1) Thorax flavous or ferruginous; wings with two bands ....*E. bifasciatus.*

1. *Echthrodelphax fairchildii P.*

Male. Black, the mandibles, the scape, and often the second joint of the antennae and the legs, pale.

Antennae very long and thin, the third and fourth joints subequal, as also the following ones; scape about equal to the second joint, and these two together subequal to the third. Head with shining areas varying in different aspects. Mesonotum shining, feebly punctured, with distinct furrows enclosing a triangular space. Propodeum with reticulate rugulosity, the meshwork not very dense. Abdomen black or pitchy, shining and smooth.

The female has already been sufficiently well described.

Hab. Hawaiian Islands; formerly on Kauai and Oahu only, but has now been established on the other islands for economic reasons.

2. *Echthrodelphax nigricollis* sp. nov.

Face, occiput, basal two and several apical joints of the antennae, a median abdominal band (often discoloured after death) and the legs, pale, yellow or testaceous. Form, size and sculpture almost as in *E. fairchildii*, but distinguished at a glance by the entirely black pronotum, and the reticulation of the propodeum is apparently more dense. Length 2-2.5 mm.

Hab. Cairns, Queensland; bred.

3. *Echthrodelphax bifasciatus*, sp. nov.

Testaceous or ferruginous, abdomen black at the extreme base; wings with a transverse, dark, narrow band at the apex of the basal cells and a dark cloud or band beneath the basal portion of the radial nervure.

Antennae less slender than in the two preceding species. Head above smooth and shining. Front lobe of pronotum smooth and shining, the posterior dull, and with excessively dense and minute microscopic sculptures; mesonotum smooth and shining;

propodeum dull, very densely rugulose in front and with regular transverse wrinkles behind. Abdomen smooth and shining. Length 2-2.5 mm.

NOTE.—I have not been able to make dissections of the mouthparts of this species, but I believe it has five-jointed maxillary palpi and does not properly belong to the genus *Echthrodelphax*.

Hab. Bundaberg and Childers, Queensland; bred.

NEODRYINUS gen. nov.

Head in dorsal aspect strongly transverse, with the vertex more or less concave; in front view, of triangular shape and strongly transverse. Ocelli in an equilateral triangle. Mandibles quadridentate, the apical tooth much the longest, the two innermost very small, the second distinctly larger than these. Maxillary palpi six-jointed, the basal joint very short, the third and following joints elongate, the third thicker than the three slender joints that follow; when laid back along the middle line of the head beneath they extend at least more than half its length. Labial palpi three-jointed. Antennae with the five terminal joints somewhat thicker than the preceding ones, so as to be subclavate, the third joint much the longest, much longer than the fourth, and not less than twice as long as the scape. Pronotum elongate, deeply transversely impressed before the middle, in front conspicuously emarginate, and with the posterior angles not nearly attaining the tegulae. Mesonotum without parapsidal furrows. Postscutellum exceedingly short in the middle. Propodeum very long, subequal in length to the mesothorax and scutellum together. Legs much as in *Dryinus* Latr. the front pair being much extended, with the trochanters very elongate, many times longer than the intermediate ones, curved and clavate, the stalk long and thin; the fourth joint of the tarsi very long, third moderately long and with a basal lamella beneath, bearing spinose hairs (there are rudiments of these structures on the preceding joint); fifth, seen from above, from its basal articulation to the true apex (or point of attachment of the pulvillus) extremely short, subquadrate, but produced beneath basally into a long process, which at rest extends back to the base of the third joint, and is bent and dilated at the tip, the chelar claw greatly developed, about as long as the fifth joint with its basal prolongation, denticulate or spinulose beneath, and with a minute tooth near the apex. Front wings with two distinct basal cells and narrow elongate stigma.

Synopsis of species of NEODRYINUS.

Females.

1. (2) Head above more or less shining........*N. koebelei.*
2. (1) Head above opaque.
3. (4) Antennae black or almost so, except the four apical joints, and the front of the scape......*N. nelsoni.*
4. (3) Antennae for the most, or a large part, pale, the sixth joint alone being somewhat infuscate in most examples, sometimes those adjoining this also dark. ....*N. raptor.*

1. *Neodryinus koebelei,* sp. nov.

Black, apex of clypeus and mandibles on the apical half (excepting the teeth) whitish or pale yellow, as also is the scape of the antennae beneath; the rest of the antennae clear testaceous. Posterior and intermediate tarsi (except the dark claw-joint) and the anterior coxae and trochanters more or less testaceous; intermediate tibiae, and front tibiae and tarsi often brown or testaceous; posterior tibiae sometimes brown or piceous; claw of chelae pale yellow or white.

Face with silvery pubescence, head longitudinally rugose and more or less shining. Anterior and posterior divisions of the pronotum subobliquely or subconcentrically rugose. Mesonotum not shining, densely reticulately rugose; the propodeum not shining, densely reticulately rugose; the propodeum strongly rugose, the numerous longitudinal wrinkles connected by transverse ones so as to form a network, not less dense than that of the mesonotum. Wings pale at the base, then with a transverse smoky band extending a little beyond the apex of the second basal cell; a second smoky transverse band, with its basal side oblique outwardly, is narrower, and on the upper side starts from about the middle of the stigma; between the two bands the wing is white; beyond the second apically, it is faintly smoky. Abdomen shining, black, impunctate. Length 4-6 mm.

Male. Black, apex of mandibles and the two basal joints of the antennae beneath (more or less) ferruginous, or testaceous; front tibiae and tarsi and intermediate and posterior tarsi testaceous, apical joints of the latter more or less infuscate. Head in front, and mesonotum dull, with dense and minute surface sculpture, and clothed with short hairs; the latter still more finely

sculptured than the head, the surface appearing exceedingly minutely granulated; postscutellum more or less shining in certain aspects; propodeum with close irregular or reticulate rugulosity. Abdomen smooth, shining, with very feeble indefinite punctures, and clothed with excessively short erect hairs. Stigma dark brown usually concolorous or nearly so.

Hab. Bundaberg and Townsville, Queensland. Bred.

2. *Neodryinus nelsoni*, sp. nov.

Rather like the preceding, but readily distinguished by the antennae, the flagellar joints being black, except the four apical ones. The front tarsi are black or piceous with the chelar claw pale, whitish. The legs generally are darker, sometimes all black, or with posterior tarsi reddish. The bands of the wings are rather darker, and the sculpture of the pronotum different, the posterior division of the pronotum being excessively finely regulose, while the sculpture of the anterior division rather resembles that of the posterior division of *N. koebelei.* More over, the surface of the head is quite dull, not more or less shining. Length as in the preceding.

Hab. Nelson on the Mulgrave, Queensland. Bred.

3. *Neodryinus raptor,* sp. nov.

Extremely close to *N. nelsoni,* but often superficially more like *N. koebelei,* since the antennae are often almost entirely pale, though shorter. The sixth joint however is never so clear as in the latter, and is often clouded or even black, as also frequently are some of the adjoining joints. Structurally the species resembles *N. nelsoni* and is abundantly distinct from *N. koebelei.* Length 3.5-5 mm.

Male. Differs from *N. koebelei* in the colour of the stigma, which is quite pale in the middle, this part contrasting very strongly with the dark margins; the intermediate and posterior tarsi are paler, almost white on the basal joint, and therefore there is a stronger contrast between this part and the dark fuscous or blackish apical joints. The basal joints of the antennae are darker beneath (or in front), being entirely black, or almost so.

N. raptor var *umbratus,* var. nov.

The second, third, and fourth antennal ioints remain more or

less dull red; the middle of the third and apex of the fourth being dark, otherwise as above. This variety or species comes nearest to *N. nelsoni.*

Hab. Bundaberg and Brisbane, Queensland. Bred.

PARADRYINUS gen. nov.

Head not concave on the vertex, and straightly (or nearly so) and distinctly margined behind the ocelli, the margin continued definitely downwards around the occipital concavity; in front view the head is triangular, and but little or not at all transverse, with the vertex slightly convex. The ocelli in a triangle, about equidistant one from another. Mandibles quadridentate, the apical tooth longest, the other three rather strong, decidedly better developed than those of *Neodryinus.* Maxillary palpi six-jointed, the four terminal joints elongated, the first of these stouter than the others and the tips reaching back to at least behind the middle and even as far as the hind margin of the head beneath. Labial palpi three-jointed. Antennae not much different from those of *Neodryinus,* the third joint being very elongate, hardly less and sometimes more than twice as long as the fourth. Pronotum long, convex, transversely constricted at the base, as long or longer than the mesonotum, its hind angles not attaining the tegulae, its anterior margin subtruncate, never distinctly emarginate as in *Neodryinus.* Mesonotum extremely convex in profile, rising up strongly and abruptly from the pronotum, in most species so strongly longitudinally rugose as to render difficult the detection of the parapsidal furrows, which, however, are present, and widely separated even at the hind margin of the mesonotum, when they are traced so far. Postscutellum of moderate length. Propodeum very long, about equal in length to the mesonotum, scutellum and postscutellum. Front legs as in *Neodryinus* but the trochanters somewhat less elongate, the basal joint of the front tarsi distinctly longer than the fourth, and the anteapical tooth of the chelar claw rather stronger.

Synopsis of species of PARADRYINUS.

Females.

1. (4) Middle and hind tibiae at the base, and the base of at least the basal joint of their tarsi, pale whitish.
2. (3) Head above, pronotum and mesonotum largely, ferruginous; sometimes however more or less clouded............................*P. koebelei.*

3. (2) Head above, pronotum except laterally and posteriorly, and the mesonotum, black or dark coloured... ....*P. varipes.*
4. (1) Middle and hind tibiae without a pale whitish basal ring.
5. (6) Third joint of antennae uniformly ferruginous....... ....*P. venator.*
6. (5) Third joint wholly or in part dark.
7. (8) Mesonotum between the parapsides much smoother and more shining than without these. ..*P. leptias.*
8. (7) Mesonotum uniformly sculptured, or almost so.
9. (10) Antennae except the second joint and base of third almost wholly ferruginous; mesonotum irregularly rugose................................ *P. gigas.*
10. (9) Antennae almost wholly black; mesonotum very regularly longitudinally rugose ....*P. threnodes.*

1. *Paradryinus koebelei*, sp. nov.

Female. Head and thorax ferruginous, more or less clouded with blackish or fuscous, propodeum usually entirely black. Abdomen ferruginous, generally more or less largely obscured with brown, fuscous, or piceous suffusion. Legs ferruginous, tibiae sometimes dark brown or nearly black, the base of the intermediate and posterior pair, and of one or two of their tarsal joints, white. Antennae testaceous or ferruginous, more or less infuscate, the scape white in front; apex of clypeus and the mandibles more or less whitish.

Head with a very dense and distinct surface rugulosity or rugulose punctuation, and with a distinct median carina extending about two-thirds of the distance from the front ocellus to the base of the clypeus; the latter emarginate at the apex. Pronotum somewhat strongly subconcentrically rugose, the mesonotum more strongly longitudinally rugose; propodeum reticulately rugose. Thorax with some sparse short hairs; abdomen smooth, shining, glabrous. Wings with a wide fuscous band across the middle of the basal cells, a narrow oblique one external to the transverse median and basal nervures and entering the apex of the first basal cell; these two bands connected below; a wide band with its inner margin oblique arises beneath the stigma and extends to near the apex of the marginal cell leaving the tip of the wings white. Length 4.5-6 mm.

Male. Black, mandibles and legs testaceous or yellow. Antennae with the scape, and some of the joints of the flagellum,

yellow; the true colour of these masked by the dark covering of short black hairs. Head and mesonotum dull, clothed with short erect hairs, and with a dense obscure rugulose or rugulosely punctate sculpture; propodeum irregularly or reticulately rugose. Abdomen shining, with a thin pubescence, and very indefinite, fine puncturation. Neuration mostly dark brown.

Hab. Bundaberg, Queensland; bred in large numbers.

2. *Paradryinus venator*, sp. nov.

The sculpture is similar to that of the preceding species, all the species of the genus, being subject to variability in intensity of sculpture.

Black, the clypeus and mandibles more or less, the sides and posterior margin of the pronotum, ferruginous. Legs darker than in the preceding species, often largely blackish or piceous, and with no basal white rings to the hind and intermediate tibiae and tarsi. Abdomen black. Wings banded as in *P. koebelei.* Antennae with the three basal and the basal part of the fourth joint ferruginous, the rest black, except that the apical joint may be more or less pale. Length 9 mm. but variable.

Male. Extremely like that of *N. koebelei,* but with the antennae slightly, but constantly, shorter and with only the two basal joints pale.

Hab. Bundaberg, Queensland; bred in numbers.

3. *Paradryinus threnodes.*

Extremely like the preceding in form and sculpture, but very distinct in general appearance, the clypeus and mandibles being entirely dark, or only for a small part pale, the pronotum at most only obscurely pale at the sides, and black along the upturned hind margin; the legs black, the front tibiae in part piceous or ferruginous, posterior and intermediate tarsi more or less ferruginous. Antennae black, apical joint more or less pale, the scape generally pitchy beneath. Length about 5-6 mm.

Hab. The Mulgrave near Cairns and Bundaberg, Queensland. Bred.

4. *Paradryinus gigas,* sp. nov.

Apex of clypeus, a spot at the base of the scape of antennae beneath, the second and third joints of the posterior and middle tarsi as well as the chelar claw, more or less whitish or cream-coloured.

The scape, the apical part of the third and all the following antennal joints, the mandibles more or less, the legs, and the basal segment of the abdomen, ferruginous; the front coxae above, and the front femora posteriorly, dark. Of the dark bands on the wings, the apical one is more restricted and less definite apically than that of the preceding species.

Head finely, but distinctly, longitudinally rugose; the pronotum with the subconcentric rugosity of *N. koebelei*, etc., but with the sculpture relatively finer, and the surface clothed with grey pubescence; mesonotum with a dense, irregularly rugose sculpture, as also the scutellum; propodeum reticulately rugose. Abdomen with the two basal segments smooth and shining, the following grey with appressed pubescence and densely and very finely punctate. Length about 10 mm.

Hab. Bundaberg, Queensland. A single specimen captured.

5. *Paradryinus leptias* sp. nov.

Black, the clypeus apically, the cheeks adjoining it and the mandibles, the front tibiae beneath, the front trochanters in front, the middle and hind tarsi (which however are largely infuscate) and the tip of abdomen, testaceous. Basal joint of antennae beneath, as also the apical angles of the emarginate clypeus, whitish; the second joint, and a narrow ring at the junction of third and fourth, and of the fourth and fifth, and the whole of the four apical joints, testaceous. Wings banded as in the preceding species, but with the basal and median of the three transverse smoky bands more confluent.

Head dull, very densely and minutely sculptured, appearing coriaceous, with very faint evidence of longitudinal rugulosity. Pronotum piceous or obscure ferruginous along its posterior margin, on the highly convex disc, shining, smooth, with hardly visible punctures; mesonotum dull, with dense surface sculpture, between the subparallel parapsidal furrows much smoother, and more or less shining; propodeum reticulately rugose. Abdomen smooth, shining, impunctate, second segment obscurely reddish at the sides. Length about 5 mm.

Hab. Near Cairns, a single female bred.

6. *Paradryinus varipes*, sp. nov.

Black, the two basal joints of the antennae, the face below these, the lateral and posterior margins of the pronotum more

or less pale, yellow, testaceous, or ferruginous; the rest of the antennae fuscous, somewhat testaceous in parts. Legs for the most part piceous, but the base of the middle and hind tibiae with a conspicuous white ring, and their tarsi white at the base. Abdomen piceous black. Sculpture of thorax very like that of *P. koebelei*, of a similar nature, but considerably finer throughout. Length about 5 mm.

Male. Black, the two basal joints of antennae rufo-piceous, the legs pale, the posterior femora and tibiae largely dark, blackish or piceous, the intermediate also obscured in a lesser degree, the tarsi nearly white, the base of hind tibiae also pallid.

Head with a very dense, minute, coriaceous sculpture; mesonotum somewhat shining in some aspects, with an excessively minute surface sculpture and some very ill-defined fine punctures, propodeum reticulately rugose. Abdomen piceous black, shining.

Hab. On the Mulgrave near Cairns, Queensland. The male was bred, but the female captured. I believe they are rightly mated.

CHLORODRYINUS gen. nov.

Like *Paradryinus* in most respects, but differs in the fact that the extremely delicate margin of the vertex posteriorly fails towards the sides, not being continued distinctly round the sides of the occipital concavity. The maxillary palpi are very long and extended back, when fully extended along the middle line, well behind the posterior margin of the head beneath. Pronotum in profile with evenly convex outline, not of the humped form of *Paradryinus*. The mesonotum is gently convex in profile, the parapsidal furrows are distinct, crenulate, subconvergent, and fail before attaining the hind margin. Basal joint of front tarsi longer than the fourth.

Chlorodryinus pallidus, sp. nov.

Testaceous, except a spot at the extreme base of the abdomen. The body is however subject to some post-mortem discoloration. Head dull, with extremely dense and minute sculpture, hardly perceptible, except under a very strong lens. Antennae very long and slender, the third joint about twice as long as the first and second together.

Pronotum smooth and shining, the dorsal outline in profile forming a regular curve. Mesonotum dull, with very dense min-

ute coriaceous sculpture both between and outside the parapsidal furrows; propodeum densely rugose. Abdomen smooth and shining, glabrous. Wings unbanded, nervures pale, yellow, stigma pallid. Length 4-5 mm.

Male. Black, mandibles, two basal joints of antennae, and all the legs pale, yellow or ferruginous. Head exceedingly densely, minutely and evenly, punctulate or coriaceous; mesonotum with a similar, but less even, sculpture; propodeum irregularly or reticulately rugose; abdomen smooth, shining, with only indefinite puncturation. Stigma pallid.

Hab. Kuranda and the Mulgrave, Queensland. Bred.

THAUMATODRYINUS gen. nov.

Agrees with *Neodryinus* and other genera in the structure of the front legs but differs greatly in other characters. Head in front view very strongly transverse, subquadrangular, the cheeks at the base of the mandibles sharply and prominently angled, the vertex strongly convex and subtumid. In dorsal aspect the head is very strongly transverse, more than twice as wide as long, the ocelli being placed in a nearly equilateral triangle. Mandibles with three strong teeth and a small inner one. Maxillary palpi extremely long, extending back far behind the head. Antennae filiform, very long and slender, as long or a little longer than the entire insect; third joint a little longer than the thick scape; fourth subequal to or a little longer than the third; fifth and sixth subequal, distinctly longer than the fourth, each of these two with a minute black tubercle before the middle, bearing a few very fine long hairs, quite different from the general pubescence; seventh with a similarly clothed tubercle at the middle; eighth much shorter than the seventh and with a simliar tubercle near the contracted apex; ninth as the preceding, but shorter; tenth with a tubercle at the middle and another at the apex and strongly constricted after the first tubercle; all these tubercles bearing hairs as already described. Pronotum about as long as wide, or as the mesonotum, in profile rising strongly upwards, and this curve continued by the mesonotum, its hind angles attaining the tegulae. Parapsidal furrows fine and feeble, but quite evident, subconvergent, but still widely separated at the base. Propodeum rather long, about as long as wide.

Thaumatodryinus koebelei, sp. nov.

Flavo-ferruginous, the petiole black, the fifth and all the fol-

lowing joints of the antennae dark. The stigma and base of radial nervure, fuscous.

Head dull, with very dense and minute, coriaceous sculpture, the clypeus smooth and shining; mesonotum dull or almost so, with sculpture similar to that of the head; scutellum somewhat shining and obscurely punctured; propodeum densely reticulately rugulose. Abdomen smooth, shining, without definite sculpture. Length about 4 mm.

Hab. Near Cairns, Queensland. Bred.

EUKOEBELEIA, gen. nov.

Head large, convex on the vertex, the sides converging behind the eyes, the latter hairy, the ocelli in a nearly equilateral triangle; the mandibles 3-dentate; the antennae with the third joint about twice as long as the second, and distinctly longer than the third. Maxillary palpi 6-jointed, labial palpi 3-jointed. Pronotum transverse, attaining the tegulae with its hind angles; mesonotum with fine, but distinct, parapsidal furrows, which are subconvergent, but still widely separated at the hind margin; prorodeum short, about as long on the dorsum as the scutellum, sharply truncate, its posterior face twice as long as the dorsal. Front legs not very long, but perfectly chelate, the fourth tarsal joint very elongate, though shorter than the basal one; fifth joint with its free extremity, which forms with one claw the tip of the chelae, not dilated and armed in the usual manner, but forming a simple curved hook; the chelar claw beneath serrately dentate. Abdomen with distinct pedicel, which is longer than wide. Wings minute, rudimentary, reaching only to the base of the abdomen, pointed at the apex.

Eukoebeleia mirabilis, sp. nov.

Dull red, the abdomen, antennae except two or three basal joints, and the propodeum black. Mandibles and legs for the most part yellowish-brown or testaceous, abdominal pedicel also pale.

Head and thorax excessively densely, minutely punctate, or coriaceous; the latter very distinctly pilose. The propodeum on the dorsal surface rugose; posteriorly, with the surface finely sculptured or granulated, and subareolate. Abdomen very smooth and shining. Length 2.5-3 mm.

Hab. Ohio, U. S. A. (Koebele); bred and captured.

NEOCHELOGYNUS gen. nov.

Of robust form. Front legs with chelate anterior tarsi, but the chelae less perfect than those of any of the preceding genera, and the legs are short, not unusually lengthened, with the femora very stout and the trochanters short.

Head subincrassate, convex, the ocelli in an isosceles triangle, much widest at the base; antennae becoming more or less wide towards the apex. Maxillary palpi six-jointed, labial palpi three-jointed. Pronotum shorter than, or scarcely subequal in length to, the mesonotum, its hind angles attaining the tegulae; mesonotum without parapsidal furrows or with these only just visible at the extreme front; propodeum as wide as long, or still shorter. Anterior tarsi with the fourth joint longish, much longer than the preceding, and about equal in length to the fifth from its basal articulation to the pulvillus, the backward prolongation of the fifth longer than the length of this joint from its basal articulation to the apex; so that the articulation is situated at about one-third of the whole length of the joint. Front wings with the radius short and straight, terminated in a knob or small thickening, or bent near the extremity. Abdomen with the basal segment greatly raised from the petiole, the basal face being on a plane strongly inclined to the dorsal surface.

Synopsis of species of NEOCHELOGYNUS.

1\. (8) Wings with one or more dark clouds or bands.
2\. (3) Front wings with only one smoky cloud extending beneath the stigma and marginal cell...*N. typicus*
3\. (2) Front wings with cloud or band as above, and with a second band at the apex of the basal cells.
4\. (5) Propodeum for a large part smooth and shining posteriorly ....*N. leiosomus.*
5\. (4) Propodeum posteriorly at most slightly shining, the surface everywhere rugulose or finely rugose.
6\. (7) Propodeum with the surface finely transversely and regularly rugose posteriorly...........*N. nitidus.*
7\. (6) Propodeum with the posterior surface excessively finely rugulose.....................*N. dimidiatus.*
8\. (1) Wings without smoky bands or clouds.
8\. (10) Antennae black..................*N. nigricornis.*
10\. (9) Antennae with the scape at least pale.
11\. (12) Antennae entirely pale............*N. pallidicornis.*
12\. (11) Antennae largely black or fuscous.

13. (16) Head in front with extremely dense minute sculpture appearing coriaceous or punctulate.
14. (15) Propodeum with posterior median area defined..... ....*N. parvulus.*
15. (14) Propodeum with no definite median area........... ....*N. coriaceus.*
16. (13) Head in front with reticulate rugose sculpture, probably due to a very shallow coarse puncturation.
17. (18) Propodeum with posterior median area dull, coriaceous; flagellum of antennae mostly black........ ....*N. destructor.*
18. (17) Propodeum with the median area smoother, hardly opaque; flagellum of antennae paler, more fuscous ....*N. cognatus.*

1. *Neochelogynus typicus,* sp. nov.

Black, all the legs, except the apical joint which is darker, the antennae except the three or four apical joints, and the mandibles, ferruginous.

Head with sparse grey hairs, the face closely, shallowly rugosely punctured, on the vertex more sparsely. Mandibles strongly quadridentate. Ocelli placed more or less in foveae; third joint of antennae elongate, distinctly longer than the fourth, which is longer and much more slender than the 5th, the latter considerably longer than broad, as also are all the following: Pronotum with the hind margin smooth, in front of this with large shallow punctures; mesonotum very sparsely, finely punctured, smooth and shining, the parapsides indicated by excessively short consute lines near the anterior margin; scutellum and postscutellum impunctate or nearly. Propodeum, seen from in front, bounded by a raised line posteriorly, which is bent forwards in the middle, the surface rugose; posteriorly with a median area evidently, though not strongly defined, by raised lines, this area being smooth and shiny except on its upper portion. Abdomen smooth, impunctate; basal tooth of the chelar claw with a very long seta reaching to the apex of the claw. Wings with the nervures strong, yellow, as also the stigma which is infuscate on its margins, the radius also dark. A vague transverse cloud lies beneath the stigma and marginal cell, occupying also part of the latter. Length about 4.5 mm.

Hab. Bundaberg; one female captured.

6. *Neochelogynus destructor,* sp. nov.

Black, the mandibles except the teeth, the two basal joints of the antennae and sometimes the third more or less, all the legs, excepting usually the front femora, ferruginous.

Female. Head with reticulate, rugose sculpture, due probably to the confluence of coarse and very shallow punctures. Antennae with the second joint fully as long as the third, fifth at its widest, much wider than the fourth, and like the sixth not much longer than its greatest width. Pronotum somewhat longitudinally rugose; the mesonotum very finely and indefinitely, sparsely punctate; propodeum with the dorsal surface short, rugose, well marked off posteriorly by a distinct raised line; posteriorly its surface dull, rugulose or granulate, the median area very distinctly marked by clear raised lines. Wings clear, neuration and stigma pale, yellow. Length 2.5-3.5 mm.

Male. Black, legs, mandibles and one or more of the basal joints of the antennae, ferruginous; usually several joints of the flagellum are more or less pale, becoming from the first more or less darkened to the apical joints, which are quite black.

Head in front with the sculpture as in the female, but much feebler and more obsolete; antennae with short, moniliform joints of subsequal length, except the scape, which equals the two following together. Pronotum very short, entirely concealed, if the head be laid back; mesonotum smooth, hardly perceptibly punctured, or impunctate; propodeum finely rugose, the posterior median area, which is quite definite, coriaceous, dull. Postmarginal nervure dark and the stigma with dark margin.

Hab. Bundaberg, Queensland; bred.

7. *Neochelogynus cognatus,* sp. nov.

Differs from the preceding as follows:

The basal two joints of the antennae are clear ferruginous, the following two or three more or less sordidly so and the rest fuscous. All the legs entirely pale. The pronotum is to a large extent smooth and shining, the mesonotum very smooth with a few scattered punctures; the propodeum posteriorly within the median area is much smoother, and hardly opaque. Length about 3 mm.

Hab. Bundaberg, Queensland; bred.

8. *Neochelogynus parvulus*, sp. nov.

Black, the legs, mandibles, except the teeth, basal two joints of antennae, ferruginous or testaceous; the rest of the antennal joints fuscous or blackish; the middle and posterior femora more or less brown.

Head in front extremely finely and closely punctulate or coriaceous; antennae with the fifth joint not abruptly wider than the fourth, the second subequal to the third in length. Pronotum dull, rugulose, except along the posterior margin, the mesonotum very smooth and shining, and, like the scutellum, impunctate or nearly so; the propodeum with the dorsal face as long as scutellum and postscutellum together, and rather strongly rugose, with distinct raised line posteriorly; its posterior face dull, finely rugulose or coriaceous, and with the median area defined. Stigma dark. Length about 2 mm.

Hab. Bundaberg, Queensland, captured; and Cairns, Queensland, bred.

9. *Neochelogynus coriaceus*, sp. nov.

Black, the scape of the antennae, mandibles for the most part, and all the legs (except the more or less brown posterior and intermediate femora and the apical joints of the tarsi) ferruginous or testaceous. Most of the joints of the flagellum of the antennae more or less obscurely testaceous beneath.

Face with excessively, dense, minute surface granulation and traces of obsolete fine punctures; second joint of the antennae about equal to the third but stouter; 6th, 7th and 8th a little, but quite distinctly, longer than wide. Pronotum and mesonotum dull (except the smooth posterior margin of the former) with the same excessively dense sculpture as the face; scutellum smooth, shining; propodeum quite short on the dorsal surface and rugose, the raised line quite distinct seen from in front; on the posterior face dull and with sculpture like that of the mesonotum with no median area defined. Abdomen smooth, shining. Neuration pale, stigma with darker margin. Length 2 mm.

Hab. Redlynch, near Cairns, bred.

10. *Neochelogynus pallidicornis*, sp. nov.

Black, the antennae, all the legs and the mandibles, pale, yellowish; the teeth of the latter ferruginous. Face shining, smooth,

with only feeble indefinite punctuation. Pronotum as long as the mesonotum and with microscopic coriaceous sculpture; the mesonotum and scutellum smooth, shining, impunctate or nearly so; propodeum, seen from in front, reticulately rugose and bounded by the usual raised line; posteriorly dull, very finely, microscopically granulate, and with the median area perceptibly marked out, but only feebly defined. Abdomen smooth, shining. Wings with pale nervures, stigma and radius brown or fuscous. Length hardly 2 mm.

Hab. Bundaberg, Queensland; bred.

PROSANTEON, gen. nov.

Head in front with coarse shallow puncturation, the vertex convex, the antennae with the joints becoming wider towards the apex of the flagellum, the widest hardly longer than wide; scape fully as long as the two following joints together. Mandibles quadridentate. Maxillary palpi six-jointed, labial three-jointed. Pronotum very short in dorsal aspect, being strongly deflected from behind forwards; mesonotum with the parapsidal furrows very widely separated and failing about the middle; propodeum with very well marked posterior median area. Front tarsi quite different from those of any of the preceding genera, and resembling *Paranteon;* fourth joint very small and short, not differing greatly from the third, fifth a nearly normal claw-joint, but with a very short, free, basal production beneath, which underlies the short fourth joint.

Prosanteon chelogynoides, sp. nov.

Black, the mandibles for the most part, the scape of the antennae, and all the legs nearly wholly, pale, yellow or testaceous, second joint of the antennae obscurely pale, the third very slightly so; posterior coxae black.

Head somewhat shining and with very shallow, coarse, close punctures, so that it appears feebly reticulately rugose; fifth joint of antennae a little wider than the fourth, the widening of the joints of the flagellum being very gradual. Mesonotum very smooth, shining, finely and sparsely punctured, propodeum with its dorsal surface at least as long as the scutellum, reticulately rugose and bounded by the usual raised line; its posterior face with the median area somewhat shining and very distinctly marked by raised lines, outside which it is dull and densely and finely

sculptured. Wings with pale yellow neuration and stigma. Length about 3 mm.

Hab. Bundaberg, Queensland; bred.

PARANTEON gen nov.

Of robust form. Head in dorsal aspect transverse, the vertex convex, maxillary palpi 6-jointed, labial three-jointed. Antennae simple, pubescent, and with longish hairs beneath, both on the scape and the flagellum, all the joints of the latter elongate, the scape as long as the two following joints together, the fourth longer than the third, but none of the flagellar joints differ much in length. Pronotum short, evidently shorter than the mesonotum, narrowed anteriorly; the mesonotum convex, with short, widely separated parapsidal furrows; the propodeum very short, subvertical from close to its anterior margin. Front legs imperfectly chelate, the chelae being incapable of extension, the fifth joint subnormal, elongate and with only a very short free basal prolongation beneath the fourth, the chelar claw closing on it and being of about the same length and without denticles beneath; fourth joint short, subnormal, hardly longer than the preceding. Front wings with large subovate stigma. Basal segment of the abdomen with strongly marked anterior and dorsal surfaces, the former abruptly inclined to the latter and much longer than it.

Paranteon myrmecophilus, sp. nov.

Black, the head, most of the thorax and basal joint of antennae ferruginous, the postscutellum and propodeum generally black or piceous, front legs more or less brown or pitchy.

Head shining and with rather indefinite punctuation, tending to rugosity; mesonotum somewhat shining, decidedly more finely punctured than the head, and the punctures not very definite; dorsal face of propodeum very short along the middle line, not longer than the post scutellum, with very fine granulate or coriaceous sculpture and the posterior raised line obsolete or wanting; posterior face shining, excessively feebly and indefinitely rugulose, and with no median area defined. Wings with neuration and stigma dark fuscous, a faint oblique cloud beneath the stigma. Length 3-4 mm.

Male. Entirely black except the front tibiae and tarsi. Face wide, subtransverse, smooth and shining, with large shallow

remote punctures; antennae submoniliform and elongate with the second joint pyriform shorter than the third; 3rd, 4th, 5th and 6th subequal, elongate, and with conspicuous, erect hairs which are as long as the width of either of these joints. Mesonotum very smooth and shining and with very few punctures; propodeum rugose in front, on its posterior face in the middle smooth and shining, but without a median area defined by raised lines. Wings very clear, the subcostal nervure and stigma dark, the median, basal and transverse median nervures quite pallid.

Hab. Bundaberg and Brisbane, Queensland; bred.

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